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Chemical Engineering

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TECHNOLOGY
DEPARTMENT

Sm

TOOL FOR DECISION MAKING

CONTROL CHARTS

YOUR PLACE IN POLITICS
ESTIMATING INSTRUMENTATION COSTS

PAGE
THREE



Photomicrograph of an air bubble entrapped in a lacquer film on mahogany panel.

Portrait of a problem . . .

Problems abound at every step in surface coating formulation and application. This portrait of a tiny blister represents only one of many challenges Shell Chemical technicians encounter in their continuing program of practical and theoretical research.

Shell's high quality ketones, alcohols, and intermediates, coupled with technical assistance to surface-coating formulators, lead to prod-

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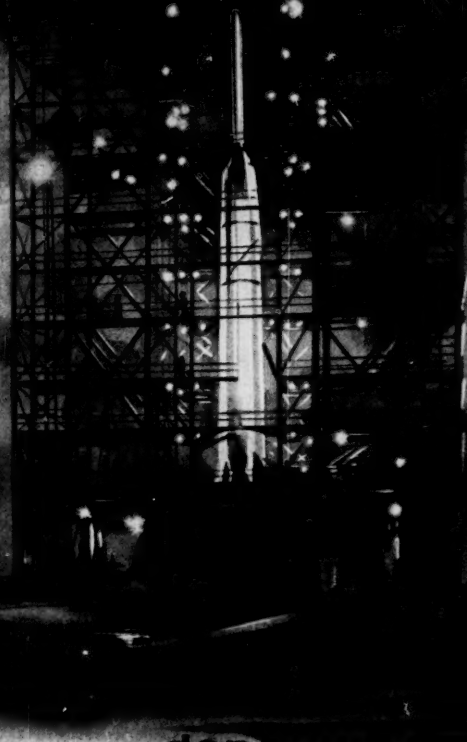
Acetone
Diacetone Alcohol
Di-Tertiary Butyl Peroxide
Ethyl Alcohol
Ethyl Amyl Ketone
Glycerine
Hexylene Glycol
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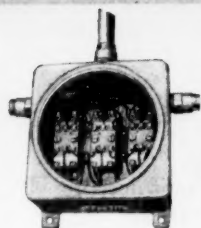
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Explosion-Proof Junction Units



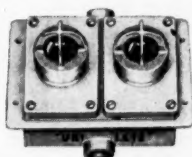
Explosion-Proof Reels



Type "GUB" Unilets—where junctions are required



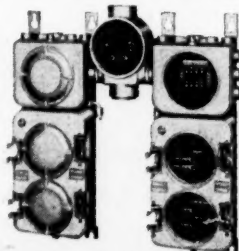
"AA-51" Lighting Fixtures—incandescent or mercury vapor lamp type . . . more light, at less cost



"EFD" Series—dust-tight pilot light and switch Unilets



"SFN" Sealing Unilets—for sealing off conduit systems at required points

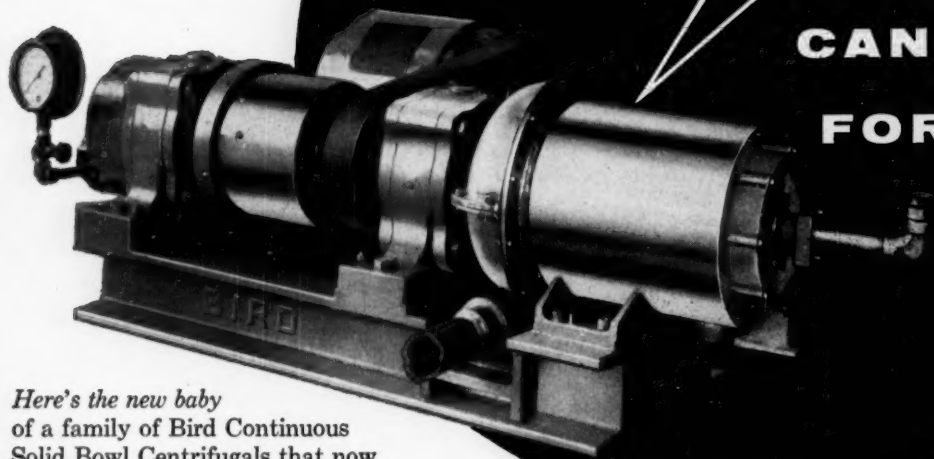


Type "ELP" Dust-Tight Panel Boards—With Covers Removed. Has a range from 2 to 16 circuits . . . 15 to 30 ampere ratings



**LOOK
WHAT THIS BIRD
CENTRIFUGAL WITH
6" SOLID BOWL**

**CAN DO
FOR YOU!**



*Here's the new baby
of a family of Bird Continuous
Solid Bowl Centrifugals that now
covers seven sizes.*

**PRODUCTION
OR PILOT WORK**

The Bird 6" is built for round-the-clock operation or for dependable pilot plant service.

HIGH CAPACITY

operating continuously at speeds up to 6000 rpm, this little unit accepts feed slurries up to 10 gpm or more — delivers solids at the rate of 500 pounds per hour or higher.

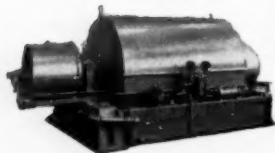
GREAT FLEXIBILITY

like its bigger brothers, the Bird 6" separates coarse or fine solids from concentrated (50%) or dilute (1%) slurries, hot or cold; on test work, speeds of both bowl and solids conveyor can be varied during operation. Bowl and conveyor are cantilever supported for quick and easy change, inspection or cleaning.

IN SMALL SPACE

overall length is less than 48 inches, height only 15½ inches.

The Bird Research and Development Center is geared up to help you select the one best design (there are 25 variations) to do the best separating job at the lowest cost.



THIS BIG BIRD, by way of contrast, has a 54" x 70" solid bowl — delivers up to 70 tons of dried solids per hour — 400 gallons of clarified liquid per minute.

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**BIRD CONTINUOUS
SOLID BOWL CENTRIFUGALS**

January 25, 1960

Chemical Engineering

Vol. 67 No. 2

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

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*FREE—for your files—Check Reader Service postcard (p. 165) for an extra copy of this recommendation to management and engineers.

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50,000,000 Lbs./Yr.

Industrial Alcohols Plant slated for Continental Oil Company

ALFOL facility to be Constructed at Lake Charles, Louisiana, Will be Completed Early in 1961

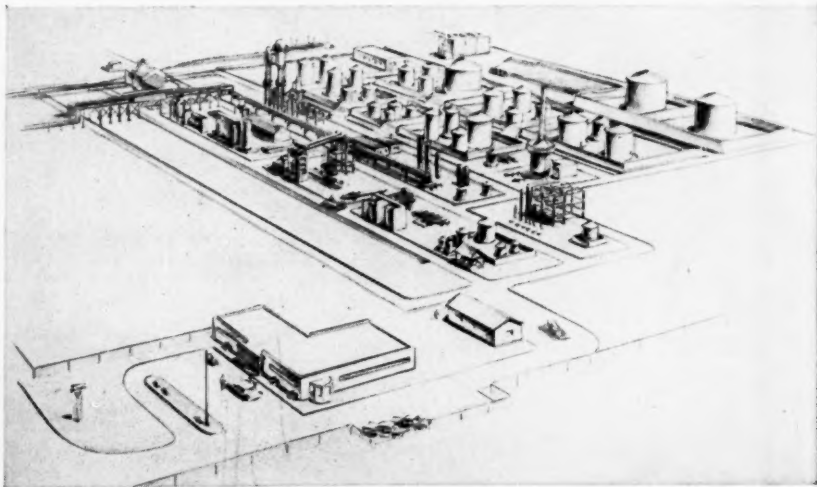
Continental Oil Company has announced that The Lummus Company has been awarded the contract to engineer and construct an Industrial Alcohols Plant at Lake Charles, Louisiana with a capacity of more than 50,000,000 lbs/yr.

These higher alcohols will be manufactured by a new technique originally conceived by Dr. Karl Ziegler. Organo-metallic catalysts are used to promote chain/growth of ethylene followed by oxidation and hydrolysis to primary straight-chain alcohols containing an even number of carbon atoms.

With completion of the plant these fatty alcohols will be available for the first time from petroleum rather than the natural sources such as tallow fat and coconut oil from which they are now produced. These primary alcohols to be marketed under the Conoco trade name of "ALFOL", will be used in the manufacture of detergents, plastics, cosmetics, lubricating oil additives, paper, textiles and emulsifiers.

The primary raw material, ethylene, for these new products will be obtained from the ethylene plant operated at Lake Charles by Petroleum Chemicals, Inc. of which Conoco owns a 50% interest. This plant was also engineered and constructed by Lummus.

In the past 50 years, Lummus has built over 800 plants to produce petrochemicals, chemicals and petroleum products. If your company is planning facilities of this kind, discuss your plans with Lummus.



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Chemical Newsfront



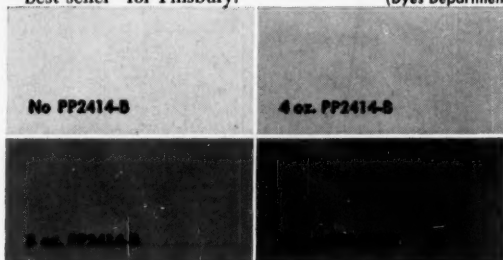
BOON TO BATHING BEAUTIES. Cyanamid's ANTIOXIDANT 425® works ceaselessly to protect clean, white, strong rubber thread—essential component of bathing suits and other “stretch” garments—against the loss of elasticity- and strength-sapping ravages of oxygen. Unrivalled in its non-staining characteristics, Antioxidant 425 also assures the ultimate in long-lasting whiteness.

(Rubber Chemicals Department)



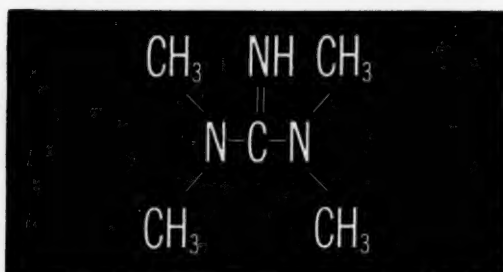
PILLSBURY PACKAGES PACK A NEW PUNCH: In that hot war for supermarket shelf space, these two Pillsbury packages have scored an impressive victory by adding Cyanamid's CALCOFLUOR® White brightener to the paper and board stock. The whiter-white base that Calcofluor provides makes package colors come alive, makes printing pop, suggests added quality and cleanliness, invites faster impulse buying... demands shelf exposure. Calcofluor White is the new Hidden Persuader, a new "best seller" for Pillsbury.

(Dyes Department)



NEW PRODUCT AIDS PAPER INDUSTRY. Cyanamid's Paper Product 2414-B, a water soluble polyacrylamide resin, is now being used in the paper industry to improve the retention of fines and pigments. In addition to reducing costly waste of pigments, other benefits are: more even coloring on both sides of the sheet, faster machine drainage, and less stream pollution from pigments. Its effectiveness as a pigment retention aid is demonstrated in the photo above. The four handsheets contain equal amounts of colored pigment while the PP2414-B content varies from zero to 16 ozs. per ton of paper as indicated. Conversely, color specifications may be maintained by the addition of PP2414-B in appropriate amounts while reducing the pigment content.

(Paper Chemicals Department)



TONGUE-TWISTER STARTS GROWING UP. This is a significant year for Cyanamid's Tetramethylguanidine (TMG). Last year, the formula for TMG appeared here as a new chemical available for research only. Now it may be ordered in drum quantities. TMG is a liquid with a slight ammoniacal odor. It boils at 159-160°C and is soluble both in water and organic solvents. Chemists in need of a strong, all-organic base should find these properties worth evaluating.

(Market Development Department)

NEWS AT A GLANCE

New spray-on antibiotic ointment has been developed by Cyanamid's Surgical Products Division. Called Surgamycin® Topical Spray Ointment, it is used in local treatment of infections—may be applied to wounds, abrasions, ulcers, draining sinuses, and similar superficial lesions, as well as to burns. The ointment requires no preparation time, may be stored without refrigeration, and produces a uniform covering when sprayed on the affected area... Utah State University, the Utah Turkey Federation, and Cyanamid are joining forces to combat staphylococcus infections which kill 100,000 turkeys a year in the U.S. The program will be carried out under a Cyanamid grant to the University... Cyanamid's Malathion insecticide has been accepted by the USDA for the control of horn flies on dairy cattle. It is the first phosphate insecticide to be cleared for such use. Greater safety and economy in coal mining are the advantages of multiple firing of explosive charges with Cyanamid's Coal King* delay electric blasting caps. The Coal King caps detonate complete rounds of permissible explosives—obviate the need for the shotfirer to return to the face between blasts, as in single-hold blasting. This results in reduced exposure of the shotfirer to dust, fumes and roof fall hazard... Cyrea®, Cyanamid's new feed-grade urea is now available. Produced at the Hamilton, Ontario plant, Cyrea is a microprilled product with non-caking and non-bridging properties.

* Trademark

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AMERICAN CYANAMID COMPANY
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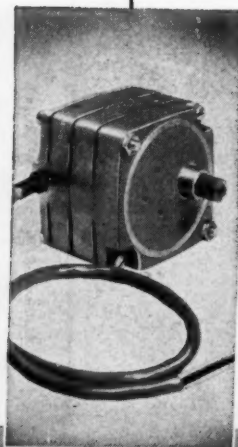
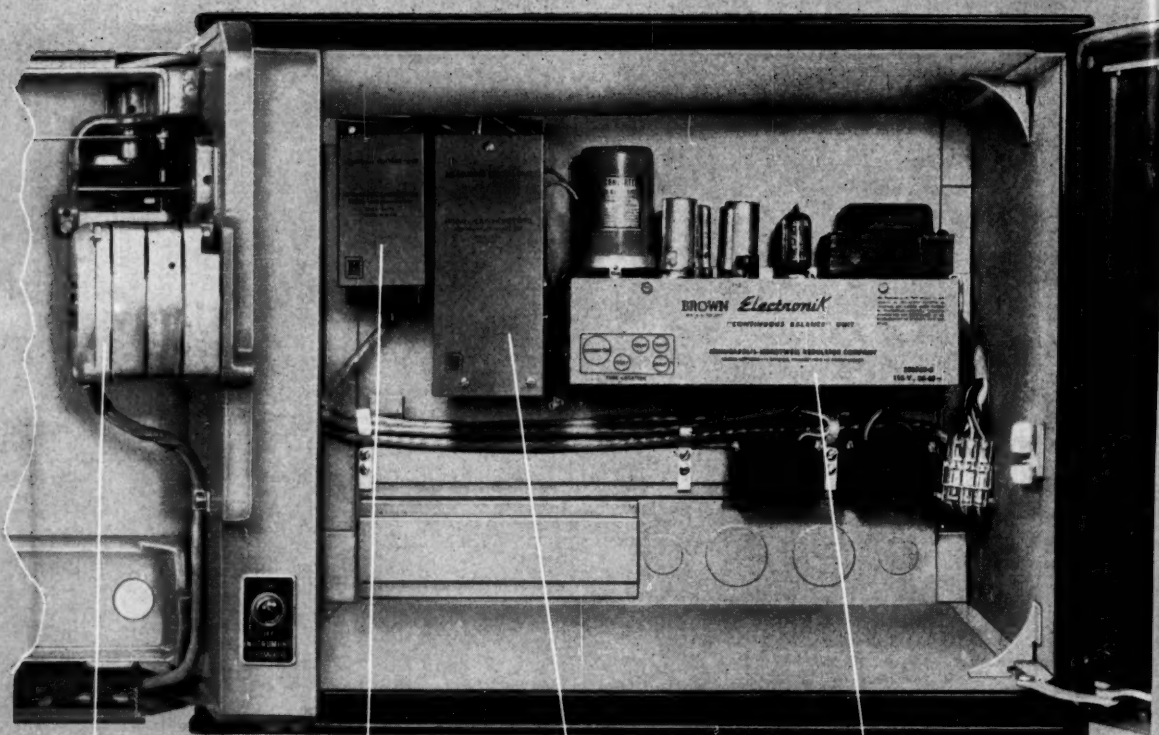
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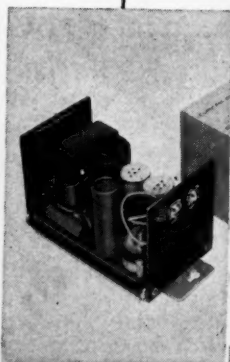
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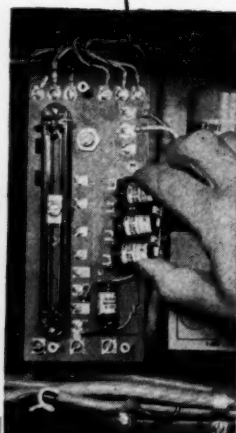
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Servo Motor has sectional housing, leakproof oil wick, printed circuits for simplified servicing. Any major part can be replaced in 2 minutes.



Constant Voltage Module—Uses Zener diodes and an ambient temperature compensator to replace standardizing mechanism.



Measuring Circuit Module—Contains easily-changed range spool panels and vernier adjustment. Range is changed simply by replacing screw-clip panels of fixed resistors.



Amplifier Module—Quick-connect design permits fast, easy removal for servicing and replacement. Circle shows quick connect plug.

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- New r
that a
- A nev
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- A ne
spool
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New modular design...

**makes *ElectroniK* potentiometers
easier to use and maintain**

Now, four great new features add new operating and servicing ease to all *ElectroniK* circular and strip chart potentiometers.

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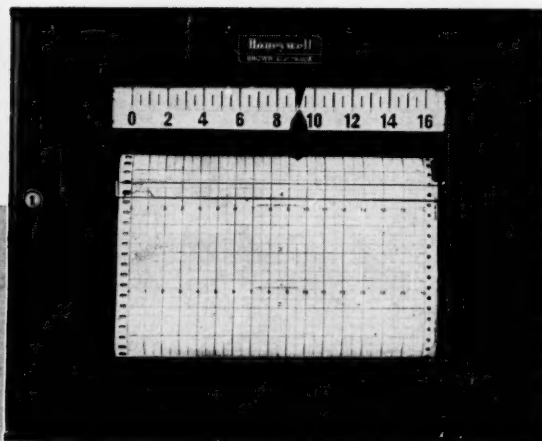
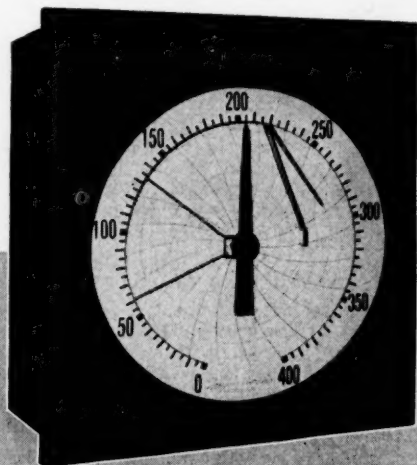
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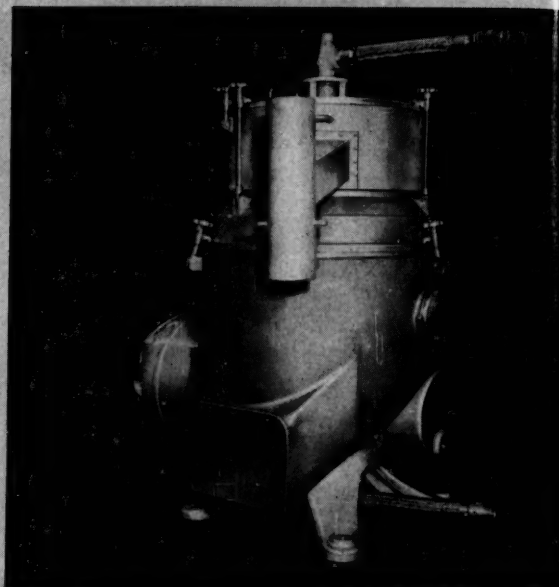
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First in Control
SINCE 1885



De Laval tackles process problems



...economically!

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CENTRIFUGES
PLATE HEAT EXCHANGERS
VIBRATING SCREENS
COMPLETE PROCESSES



**A sticky problem
with a hot solution**

Problem: To heat a solution of 45% Latex concentration from 117°F to 170°F without precipitating excessive coagulum.

Solution: De Laval Plate Heat Exchanger. Shell & Tube exchangers could not be used; they'd be impossible to clean. Instead, this company installed a two section De Laval Plate Heat Exchanger, each section handling 114,500 pounds per hour of the latex concentration. With Type 316 stainless steel plates and a total heat transfer surface of 1,090 sq. feet, the unit has been in operation (and operating perfectly) for almost two years.

Even in processing of a solution as sticky as latex, the De Laval Plate Heat Exchanger is cleaned *in place* by circulation of a cleaning solution immediately following the heating of the latex. For periodic cleaning other than by circulation, the plate pack is easily opened. All heat transfer surfaces are immediately exposed for manual cleaning with a minimum of trouble.

Processor of new detergent cleaned up recovery problem with fast, non-stop separator

Problem: A processor developing a new detergent made from vegetable oil needed an efficient method of recovering the expensive catalyst in re-usable form. Previous attempts had recovered non-dispersible catalyst in a hard cake form.

Solution: A De Laval AC-VO "Nozzle-Matic" Centrifuge. Since the heavy phase in the separation (containing the catalyst) is thrown to the bowl wall and discharged *continuously* as part of

the machine's normal operation, the catalyst is recovered in a thick slurry. In this form, it is easily re-dispersed.

This particular unit was also supplied with a heavy phase recirculation feature. As the heavy phase is discharged through the nozzles built into the bowl wall, it is picked up and recirculated to the centrifuge bowl. The result is a higher concentration of the catalyst, and in a state of maximum clarification.

The higher capacities possible with De Laval continuous discharge centrifuges were important to this processor, too. Combined with the fast operation, they insured maximum catalyst life. Slow operation had been a factor in the hard caking of the catalyst in previous attempts at recovery.

Wherever recovery of a solid is important in your process, you should consider the different types of solids concentrators we make at De Laval. There is a type for every recovery operation.

Why not drop us a line for further information? Just tell us the type of recovery which interests you. There is no obligation, of course.

ONE PROBLEM AFTER ANOTHER



"Most process engineers are in the 'problem business.' Ours are too — up to their necks!

"Often, our experience and extensive performance data permits on-the-spot solutions to these problems. At other times, pre-testing process conditions in our own pilot plant pins down the best equipment type — the most economical size. Examples are shown here of how De Laval's experience and facilities have served others — could serve you!"

Fred Wheelwright, Industrial Sales Manager

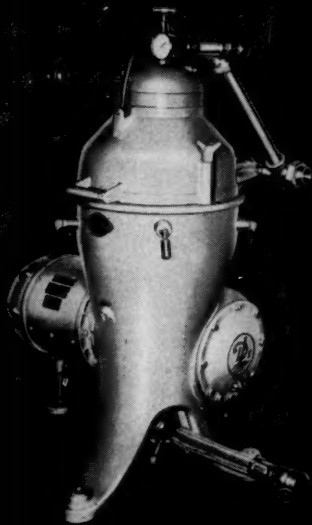
Viscous liquid easily separated in pressurized centrifuge

Problem: A viscous, high-melting-point rubber accelerator was to be separated from an alcoholic reaction mixture.

Solution: Centrifugal separation at liquefying temperatures. This also meant maintaining pressure to avoid alcohol boil-off. An open-system separation was not practical but tests at De Laval's pilot plant proved the Hermetic Centrifuge could handle this job. In actual production, instantaneous and complete separation was easily achieved with a De Laval Hermetic Centrifuge to pro-

vide a clean product and no loss of the alcohol phase.

Similar separation problems involving elevated temperatures and pressures can be handled by the many standard types of De Laval Hermetics. Corrosion-resistant and easy to clean, these centrifuges meet all the requirements of industrial service. As in the case quoted here, our technical service in providing the *right* design for volume and purity requirements often includes pilot plant pre-testing before shipment. Please write for details.





**"No lubricant to
contaminate ladings"**

QCF® non-lubricated Ball Valves

ACF Ball Valves are specially designed for ladings that require absolute purity. There is no lubricant, no possibility of contamination. The chrome-plated ball is suspended between Teflon seats under compression for leakproof sealing.

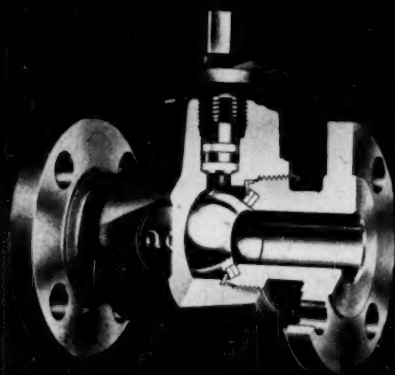
A quick quarter-turn operates this rugged valve. Specify it. You'll get efficient, economical performance. *Available at leading supply stores everywhere.*

Service-proved for 5½ years with such ladings as: gasoline
• alkalis • liquefied petroleum gases • acetone • synthetic fuels
• paint solvents • toluol • alcohol.

WRITE FOR CATALOG 1000



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INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS



ACF non-lubricated Ball Valves feature full bore conduits, Teflon stem gaskets and seats that are sealed from the lading flow.

Working Pressures: In carbon steel with ASA ratings of 150 and 300, and a few sizes in ASA 600; in semi-steel with 200 and 400 pound ratings.

Sizes: ½" through 6".

Safe-pouring space savers that stack up...

HACKNEY STAINLESS STEEL CHEMICAL CONTAINERS

Here are the chemical containers everybody likes—shippers, carriers, handlers, users! Lightweight, strong, leakproof and stackable, they protect your dangerous or corrosive products, eliminate accidental breakage, and safeguard handlers.

Hackney chemical containers are built of Types 304 and 316 stainless steel. Bottom foot ring fits snugly over the top ring of the barrel beneath to permit safe stacking. That means real savings in

warehouse space and handling time. Full-curved top and bottom rings give handlers full gripping areas. Dropping and spilling are cut to a minimum. And for further safety, a splashproof pouring spout is available as an optional accessory.

Hackney chemical containers hold approximately 15½ gallons of liquid. Size: approximately 17 5/8" x 22 5/8". Owner's name can be embossed in foot ring. For more details, write to the address below.



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1447 South 66th Street, Milwaukee 14, Wisconsin

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CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS



Dann Goodson, *Manager Motor-Driven Compressor Sales,*
The Cooper-Bessemer Corporation, explains...

How Cooper-Bessemer's new, compact Air Compressors simplify installation and reduce costs

The DMR compressors shown here are two models of a new line of compact, 720 rpm machines, unmatched in reliability. With these units, Cooper-Bessemer introduces a new standard of installation economy. So highly compact, the DMR compressors are readily installed in existing space, avoiding the need for additional housing facilities. They can be located at strategic points throughout the plant to supplement existing air line services without additional feeders to help supply your production needs at minimum cost.

The new DMR units come completely equipped with integral motor-drive and intercooler...ready for operation. Their control can also be integrally mounted as shown. They are available for two-stage applications in the range of 500 to 2000 cfm and discharge pressures of 80 to 125 psi...also for single-stage and three-stage operation.

The introduction of this new line of air compressors, plus the portable tool facilities of our new subsidiary, The Rotor Tool Company, enable Cooper-Bessemer to give you full-scope service for your industrial air power needs. Call the nearby Cooper-Bessemer office or air compressor agent for Bulletin No. 94 on the new DMR line.



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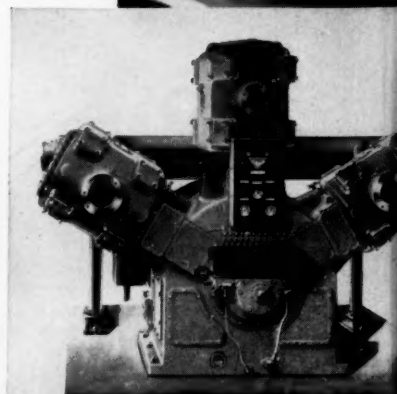
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The Rotor Tool Company ... Cleveland

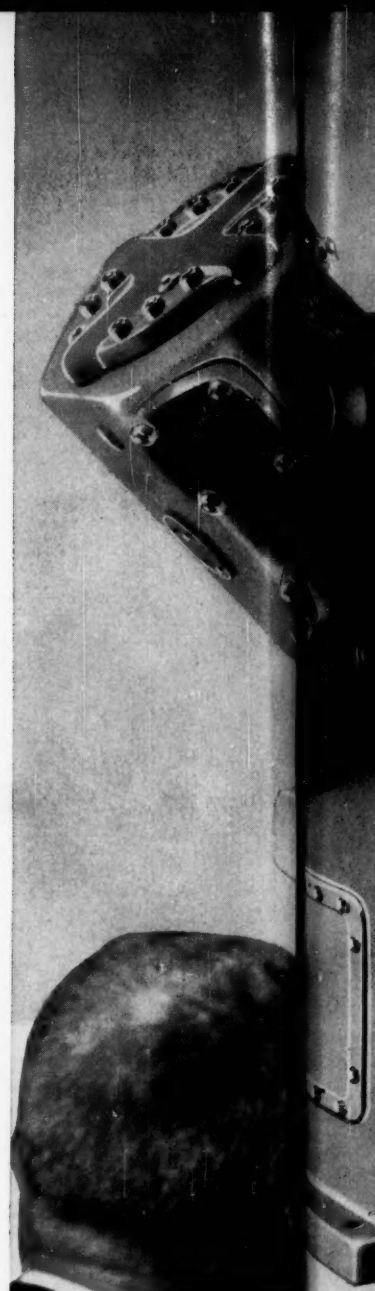
Cooper-Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, TURBINE OR MOTOR DRIVEN



New DMR-3 two-stage air compressor with
integral control. Ratings of 300-350 hp.





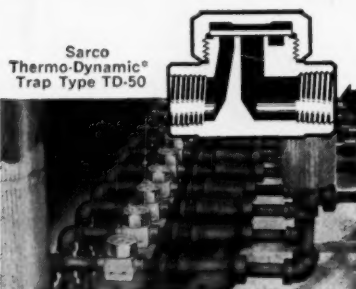
NEW
COOPER-BESSEMER
DMR-2 TWO-STAGE
AIR COMPRESSOR
WITH
EN-TRONIC CONTROL
100 TO 250 HP



SARCO

NOW... MATCH STEAM TRAPS TO

THERE'S no such thing as an all-purpose steam trap. That's why it pays to know what each trap has to offer. Here are five examples that demonstrate how you can match the correct steam trap type to the exact requirements of *each* application.

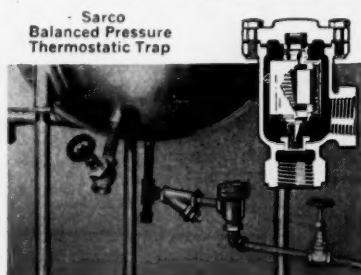


EXAMPLE 1: Outside Tracer Lines: A tough set of requirements

One of the most demanding sets of requirements a steam trap has to face is found in *outside steam tracing*. The trap must not only rid tracer lines of condensate and air immediately they're formed, but it must do so under exacting conditions. Pressures on each trap may vary widely. Installations may be remote and inaccessible to service. Water hammer may be a constant threat; freezing may be a hazard. Only the unique Thermo-Dynamic trap takes all these demands in stride. The Sarco TD-50 operates perfectly *without adjustment* through its full pressure range of 10-600 psi. It's virtually immune to water hammer and won't freeze when installed with a free discharge. Maintenance is, therefore,

negligible. Compact, requiring no external support, the TD-50 is just about the easiest trap in the world to install. Once it's installed, you can forget it. You can count on an extremely long, trouble-free service life with minimum maintenance attention.

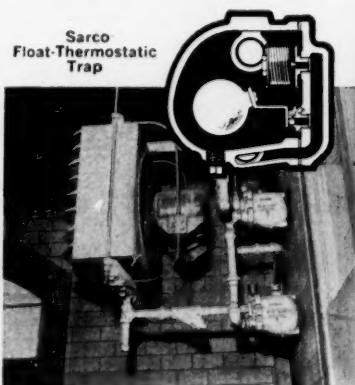
More closely than any other model, the TD-50 approximates an all-purpose trap. However, special application requirements might dictate the use of another type of Sarco trap. Sarco engineers stand ready to help you solve any trapping problems.



EXAMPLE 2: For steam jacketed process kettles: a trap that operates immediately on start-up and self adjusts to both low and high pressures

When a large steam-jacketed process kettle starts up, the condensate load

is high, and all air in the jacket must be released quickly. At this stage, however, the jacket pressure is low; yet it builds up rapidly as the process continues. Because a SARCO No. 9 Balanced Pressure Thermostatic Trap is wide open on start-up, it releases initial air and condensate without the need for a bypass. And because it is self-adjusting, it works just as efficiently during the first processing stage when the jacket pressure is high. There are no seats to change for various working pressures. You can see why it is the obvious choice for steam jacketed process kettles.



EXAMPLE 3: How to prevent water-logging in unit heaters and blast coils

All unit heaters and blast coils have a relatively small internal volume in comparison with their steam condensing capacity. Even slight water-logging can reduce heat output seri-

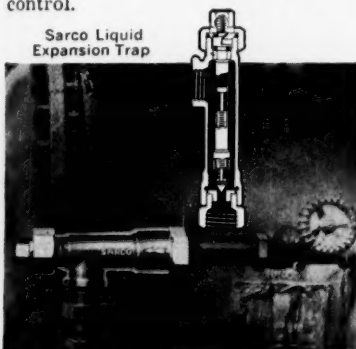
Impartial advice on trapping because
ONLY SARCO MAKES ALL 5 STEAM TRAP TYPES

TOPICS



S TO YOUR TRAPPING NEEDS

ously. Pressures may vary widely under automatic temperature control and so may the load because of variable demand. A trap to handle this application must adjust itself instantly to pressure and load changes. The most precise answer to this problem is the SARCO Float and Thermostatic Trap—and here's why: it releases air on start-up and during running, and, because it discharges condensate continuously, it does not set up in the system violent pressure changes that would upset close control.



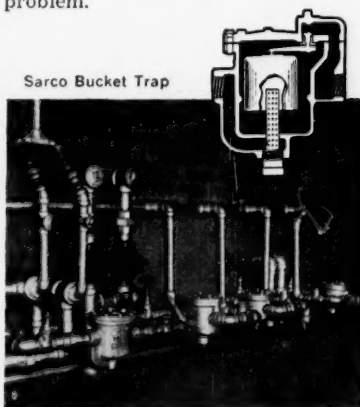
EXAMPLE 4: How to release low temperature condensate

When condensate cannot be returned to the boiler feed tank either because of distance or because it may be contaminated, it's economical to utilize some of the sensible heat as well as the latent heat of the steam.

For this purpose a trap must be capable of releasing condensate to temperatures as low as 100° F.

The sound trap selection here is

the SARCO No. 871 Liquid Expansion Trap because it can be set to release condensate at temperatures down to 100° F. regardless of supply pressure. This performance assures maximum steam economy. The Sarco No. 871 handles the starting load easily because of its wide open valve, which throttles the flow as the condensate temperature rises. Furthermore waterhammer cannot reach the operating element. No other type is as nearly perfect for this specific problem.



EXAMPLE 5: Economic handling of Water Hammer and Corrosive Conditions

In applications in which water hammer or corrosive conditions are encountered but in which low pressures or extremely high back pressures preclude the use of the Thermo-Dynamic trap, the Sarco Inverted Bucket Trap is recommended. While

the Sarco I. B. is not exactly a fuel miser, its relatively rugged construction will withstand considerable water hammer; and, when it is fitted with stainless steel internal parts, it offers excellent resistance to corrosion.

* * *

CONCLUSION: The right application is the economical installation

When you choose steam traps that serve their purpose without frequent adjustment, and without maintenance or replacement problems, you save on down-time, man-hours, spare parts, and production slowdowns.

You can get the money-saving solution to every trap selection problem by consulting Sarco. You get impartial solutions, because only Sarco makes all 5 types of steam traps: Thermo-Dynamic*, Thermostatic, Float Thermostatic, Liquid Expansion, and Bucket.

You also get the benefit of Sarco's 50 years of specialized experience in the manufacture and application of temperature regulators, industrial air vents, pipeline strainers, dial and industrial thermometers, heating and cooling controls, heat exchangers, heating control systems and heating specialties.

For literature or impartial help in solving your steam trapping or control problems, contact your local Sarco Sales Representative, or write direct to Sarco.

1440

*U.S. Pat. No. 2,817,353, T.M. Reg. U.S. Pat. Off.

SARCO

COMPANY, INC.

635 Madison Avenue,
New York 22, N. Y.
Plant: Bethlehem, Pa.

Remember CLAYMONT



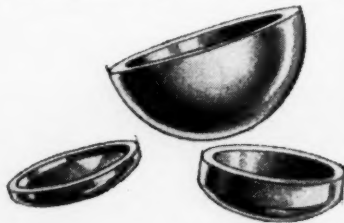
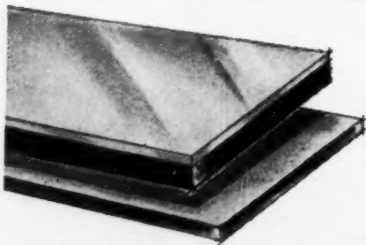
TO fabricators and equipment manufacturers, the Image of CF&I means single-source service for many of their steel plate requirements. This giant steelman reflects the integrated steel production and plate fabricating facilities of CF&I's Claymont, Delaware plant.

Claymont makes its own steel, rolls its own plate and performs every plate-fabricating operation, exercising step-by-step quality controls within the Claymont plant. Consequently, steel plate availability is no

problem, and customer specifications are met exactly.

Small or large-quantity orders are handled with equal facility. Quick shipments from stocks are available on many items, and delivery promises are kept on special-to-order production.

Whether you need an added source or want a single source for steel plates and steel plate products, contact Claymont. Full details and prompt service are available through any CF&I sales office—and there's one near you.



CARBON
ALLOY
A-203
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pressur
A-202
and 41
STAINLESS
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only,

For steel plates...heads... fabricated plate products

Claymont Steel Plates

CARBON—to all standard ASTM and AISI specifications.

ALLOY—including nickel-bearing ASTM specifications A-203 and A-353 for liquid oxygen storage and other low temperature applications... "chrome-moly" ASTM specification A-387 (all grades) for high temperature and high pressure applications... as well as ASTM specifications A-202, A-204, A-225, A-302 and AISI specifications 4140 and 4130.

STAINLESS-CLAD—provides the same protection against corrosion, abrasion and contamination as solid stainless—plus the economy of carbon steel backing plates. Cladding and backing are inseparably bonded together. Claddings are available in thicknesses from 5% to 50% of total plate gage. AISI stainless specifications 304, 304L, 316, 316L, 316Cb, 321, 347, 405, 410, 430 are provided. ASTM A-263 and A-264 specifications can be supplied also.

CLAY-LOY high strength low alloy steel plates—comply with ASTM specification A-242. Ideal for structural and equipment applications where weight-saving is important.

CF&I LECTRO-CLAD nickel plated steel plates—give positive protection against product contamination and discoloration, at less cost than solid nickel.

Claymont Spun and Pressed Heads

Claymont has complete facilities to produce spun or pressed heads... in diameters from 9 inches to 19 feet... in gages from 3/16" to 6"... in the following shapes: standard or ASME flanged and dished, conical, hemispherical, elliptical, flanged and reverse dished, dished only, flared and dished, flanged and shallow dished, flanged

only, and large segmented and welded shapes. Metals include carbon, alloy, stainless or stainless-clad steels; aluminum, aluminum alloy, brass, bronze, copper, Hastelloy, inconel, monel, and other ferrous and non-ferrous metals supplied by our customers.

Large stocks of the more popular sizes of Claymont Heads, flanged and dished in carbon steels, are maintained at the following CF&I warehouses:

**Chicago • Claymont, Delaware • Houston • Los Angeles
San Leandro, California • Tulsa**

Claymont also manufactures a complete line of fittings for pressure vessels, such as manhole and handhole fittings, elliptical manhole rings and storage tank manhole frames and covers.

Claymont Fabricated Steel Plate Products

Claymont's production-line fabrications shop is completely equipped to convert the steel plate of your choice into completely-fabricated assemblies or simple, single-operation parts or components. Job-shop facilities of all kinds are available to furnish welded, rolled, sheared, flame-cut, pressed, punched or machined products to exacting specifications. Claymont's fabricated structural weldments range from 120-ton fully-welded sections to such items as bearing assemblies, base and tie plates, wedges, gussets and straps.

Use Claymont's complete plate fabrications facilities as an extension of your own shop. Have difficult, time-consuming operations performed *before* the steel plate is delivered, and save shipping and handling on the part of the plate that you can't use.

If you use any of the steel plate products listed above, or large diameter API Pipe, contact the nearest CF&I sales office.

Claymont Steel Products

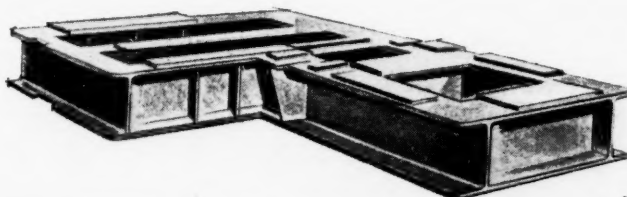
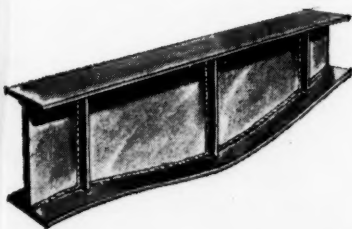
THE COLORADO FUEL AND IRON CORPORATION



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7086

**ENGINEERED
TEFLON* PRODUCTS**
for Chemical Processing

**BEST AT EXTREME TEMPERATURES
WHERE CORROSIVES ARE PRESENT**

Garlock Teflon-jacketed Gaskets give you the advantage of using Teflon without sacrificing resiliency and deformability . . . particularly important on your glass-lined process equipment, light metal flanges, and glass pipe flanges and fittings. Garlock offers four basic designs—slit envelope, milled envelope, formed shield, double jacket—and a wide selection of filler materials and thicknesses. Catalog AD-154.

Garlock SOLID Teflon and Teflon-lined Expansion Joints, exposed to the most reactive chemicals, guard costly piping against pressure surges from pumps, compressors and engines . . . reduce flange breakage, prevent stress, compensate for misalignment. Catalog AD-137.

Garlock LATTICE-BRAID† Teflon Packings are perfect on pumps and engines in petrochemical, oil and gas service. They are strong, long-lasting, chemically inert. Withstand temperatures ranging from -120°F to $+500^{\circ}\text{F}$. Less gland pressure is required to effect an adequate seal, resulting in longer sleeve and packing life, less downtime. Catalog AD-131.

Garlock CHEMISEAL† Mechanical Seals possess greater immunity to corrosion and are more economical than any other design offered. Easy to handle and install, do not score shafts, engineered to give a life expectancy many times that of other seals. Available in standard sizes to fit all pump shafts $\frac{1}{8}$ " to $2\frac{1}{8}$ " shaft. Seals against all media in pressures to 100 psi at 75°C or 75 psi at 100°C . Catalog AD-164.

G A R L O C K

For more complete information, call your Garlock representative at one of Garlock's 26 sales offices and warehouses throughout the U.S. and Canada. Or, write The Garlock Packing Company, Palmyra, New York.

Canadian Div.: The Garlock Packing Company of Canada Ltd.

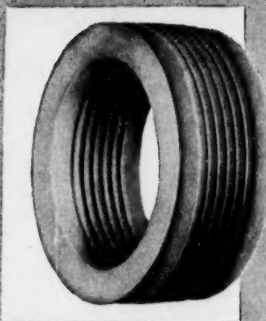
Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

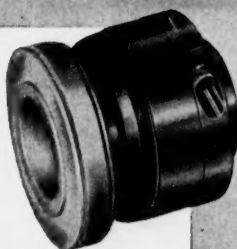
†Registered Trademark

*DuPont Trademark for TFE Fluorocarbon Resin

Teflon-jacketed
offer the
of appli-
without
resiliency
suited
flanges
process



Teflon Expansion Joints protect expensive piping from damage due to stress, misalignment . . . resist solvents, acids, caustics to 125 psi.



CHEMISEAL Mechanical Seals can be installed quickly and simply, offer leak-proof sealing without shaft wear . . . resist most reactive chemicals.



LATTICE-BRAID Teflon Packing lasts far beyond the limits of other packings . . . gives maximum service over wide range of temperatures, pressures. Only Garlock can give you LATTICE-BRAID.

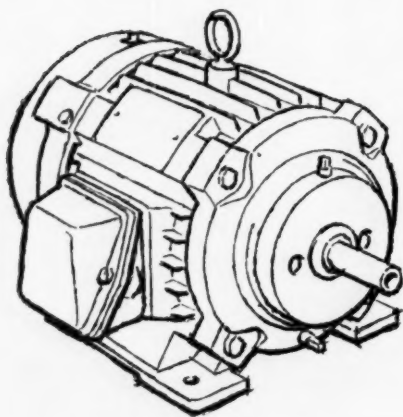


Teflon-jacketed Gaskets offer the advantage of applying Teflon without the loss of resiliency . . . ideally suited to pipes, flanges in chemical processing.



M. K. Sieber, Sales Engineer, Charleston, W. Va. District Office, Reliance Electric & Engineering Company.

"Duty Master can handle the meanest motor job you can name.



"Every possible safeguard has been built into these totally-protected Duty Masters. They actually exceed the rigid specifications set up to protect users from corrosion, explosion, dirt or violent weather.

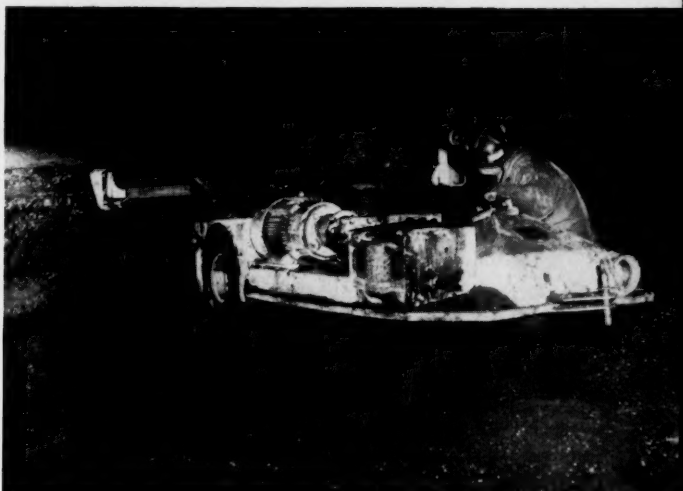
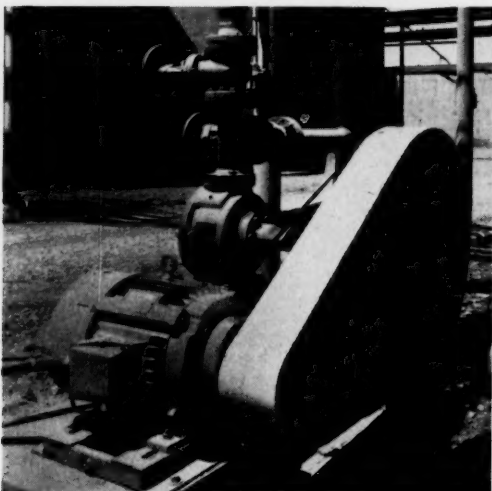
"In my territory, motor protection like this is pretty important, and Duty Master is living up to its reputation as a really rugged motor."

RELIANCE



Duty Master
A-C. MOTOR

Duty Mast



The combination of Duty Master's protective design, engineering and construction gives you plenty of reasons why these motors perform so consistently well at peak loads.

The explosion-proof Duty Master, for example, meets the qualifications of Class I, Group C and D; Class II, Groups E, F and G in hazardous locations as defined by the National Electrical Code . . . actually exceeds requirements of Underwriters Laboratories—and it's corrosion-proof as well!

Specifically, Corrosion-proof Duty Masters are immune to acids, alkalis and solvents . . . Weather-proof motors resist rain, sleet, snow and wind-blown dust. The Dust-proof Duty Master, being strictly what the name implies, even is guarded against highly

magnetic, abrasive taconite dust.

The vital factor to be recognized is Duty Master's *protection from the inside out* . . . in stator windings, rotor and bearing system. Insulation, as well as enclosure, is impervious to oil, water, acids, chemicals, dust and dirt. The lubrication system employs the famous Reliance "Metermatic", feeding precise amounts of grease to double-shielded bearings. It is impossible to under-grease or over-grease Duty Master.

In coal mines and chemical plants . . . in extremes of weather or damaging dust, Duty Master tackles the toughest jobs. Your nearest Reliance Sales Engineer will give you all the technical proof you need. Call him, or if you prefer, write for full information.

R-1656

Product of the combined
resources of
Reliance Electric and
Engineering Company and its
Master and Reeves Divisions

**RELIANCE ELECTRIC AND
ENGINEERING CO.**

DEPT. 131A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities



Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V&S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

FLUIDICS* AT WORK



Now . . . GLASTEEL pipe that you can field-cut

That's new Pfaudler F-C Glasteel pipe* you see being cut with a standard, dry abrasive cutoff wheel.

The F-C stands for "field cut." The pipe itself is steel on the outside for strength, borosilicate glass on the inside for corrosion resistance. Once you've cut the length you want, you thread and then fire-polish with a small, portable furnace. (Furnace available from Pfaudler at a modest cost that you will completely recover through savings in a few installations.) You finish the pipe end with a belt sander to make sure that the gasket seat is flat and the flange connection seal-tight.

Glass lining for this new pipe is $\frac{1}{8}$ inch thick, so you can expect substantially longer service life even with corrosive and/or abrasive fluids. Rated at 150 psi and available in $1\frac{1}{2}$, 2 and 3 inch diameters, F-C pipe can be used with all acids (except HF) to 350°F. and with all mild alkalis at moderate temperatures.

Moreover, since glass is inert, you will also find this pipe useful for those products which must be kept free from con-

tamination. And note, too, that because glass is smooth, there's little chance for build-up with sticky materials.

Aside from the fire-polishing furnace, you will find the tools needed for handling F-C Glasteel pipe in most plant maintenance shops. There is no need to engineer a piping layout to the last $\frac{1}{8}$ inch. Installation and modification are easy, and very little maintenance is required.

As of now, you can get limited quantities from stock in lengths through 10 feet. For Bulletin No. 989 or for answers to specific questions on availability and delivery, please write to our Pfaudler Division, Dept. CE-10, Rochester 3, N. Y.

*Patent applied for



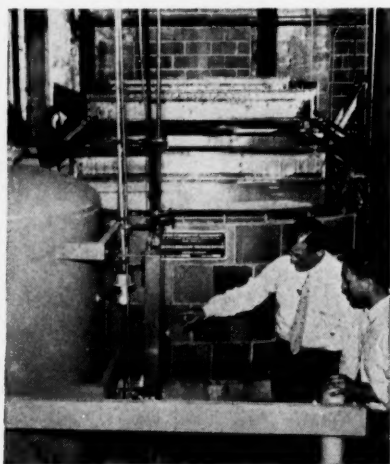
Thread-on flange used with F-C Glasteel pipe is ASA 150# Series. Gasket features corrosion-resistant Teflon envelope at product contact area.

In-plant "airlift" ends waste disposal problems, reclaims usable materials

You start with a specially designed mechanism for forcing air into solution with your waste waters. Then, feed the waters into a tank open to atmospheric pressure. This sudden pressure drop forces the dissolved air to bubble out of the solution. The bubbles collect around minute solid particles and *lift* them to the surface, where you easily skim them off.

Simple? Yes. Efficient? Extremely. Do you have to build it yourself? No, because you can already get it from Permutit.

It's called the Permutit Colloidair System and it's designed for handling waste waters containing solids. For example, International Harvester uses Colloidair in their Ft. Wayne plant. The waste waters hold soluble and insoluble oils, alkaline cleaner fluids, mineral acids, corrosive salts and other contaminants. Obviously, such effluent is not suitable for dumping into an open stream. But with Colloidair, solids are "airlifted" to the surface for disposal in an open drying pit. And the clarified liquids (less than 10 ppm oil) go into the stream without contaminating it.

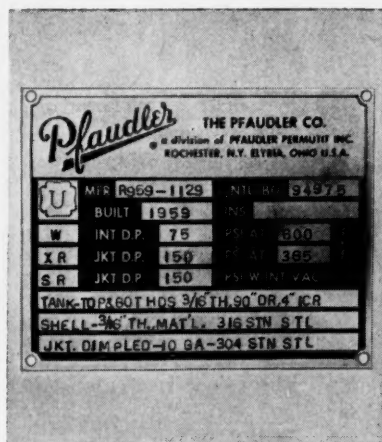


The Homasote Company, makers of fiber wallboard in Trenton, N. J., runs waste white water through the Colloidair System. Bubbled-out fibers are reclaimed; the clarified water is clear enough for use in pump glands, stuffing boxes and for general cleanup.

You can get a Permutit Colloidair System in steel or tile . . . and with special corrosionproof lining. For more details on the in-plant "airlift" for waste waters, or waste treatment in general, write for our Colloidair booklet and our Industrial Waste Treatment bulletin.

Code approval is one measure of quality in stainless reactors

This code plate on a Pfaudler stainless steel reactor tells you that every detail of construction—materials, design, workmanship—is of the highest quality.



But how can you measure quality on a non-code vessel?

At Pfaudler, both are essentially the same. Whether you require code approval or not, specify X-ray inspection, need type 304 or 316 stainless, your reactor is made in the same plants, by the same workers, following the same designs and under the same quality standards.

There is more than quality in the Pfaudler hallmark. It also includes:

5 to 2,000 gallon capacities. Complete range of sizes for convenient scale-up of your process, lab to pilot plant to production.

Standard design. Makes process line change-over easy; reduces cost of units; lets us stock reactors, provide 2-week delivery on certain sizes.

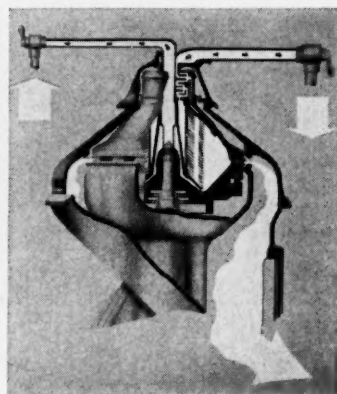
"Dimpled" jackets. Pfaudler's unique stainless dimpled construction enables you to operate economically at temperatures as high as 600°F. and jacket pressures to 150 psi. Code approved. 175 psi is available on custom designs. Dimpled jackets also give you higher heat transfer rates than conventional designs.

Dollar savings. We help you pick lowest cost construction—usually conventional jacket design up to 750 gallon size and/or 100 psi, then "dimpled" construction for higher capacities or pressures.

Free bulletin. You can study the details and specifications of Pfaudler stainless steel reactors in our Bulletin 944. Write for a copy.

Do you have these separating problems?

- ... Solids' weight slightly heavier than liquids.
- ... Fine, slimy or abrasive particles.
- ... Liquids that are viscous, aerated or mixed.
- ... Over 99% solids removal.
- ... Concentration of solids to 100% by volume.



Solids periodically ejected from bowl by hydraulic opening of slots.

One centrifuge can and *does* handle these difficult separations—Pfaudler's Titan Superjector.

How? The Titan generates a settling power of 7800 times gravity. Much more force than most continuous centrifuges.

It discharges particle sizes to 1/8" dia. through slots 3/8" high by 5" long.

A three-jet hydraulic system provides full slot opening and closing in 1/10 second and positive sealing of bowl.

"Selecteject" control also permits continuous feed; discharges only solids while maintaining a sludge blanket at bowl periphery.

See for yourself. Schedule a test in the Pfaudler lab or in your own plant, using a Pfaudler field evaluation unit.

Write for more information and a copy of our Bulletin No. 946.

FLUIDICS AROUND THE WORLD

Pfaudler Permutit is a world-wide company with manufacturing plants in:

Germany: Pfaudler-Werke A.G.

Great Britain: Enamelled Metal Products Corp. Ltd.

Canada: Ideal Welding Co. Ltd.

Mexico: Arteacero-Pfaudler, S.A.

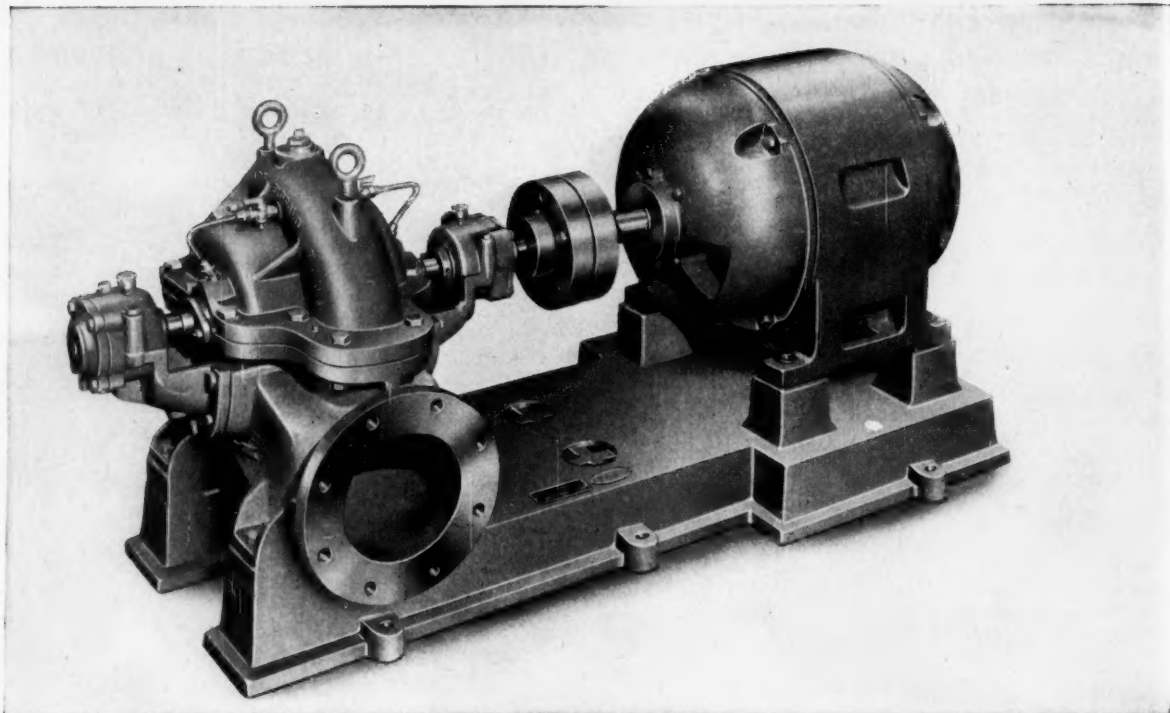
Japan: Shinko-Pfaudler Co., Ltd. as well as four plants in the U.S.A.

*FLUIDICS is a new Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.



PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS...the science of fluid processes



"Buffalo" Double Suction Pump for Clear Water Service

3-WAY ECONOMY WITH THESE "BUFFALO" PUMPS

1. Minimum Maintenance Cost
2. Minimum of Costly Time-Outs
3. Minimum Service Costs

"Buffalo" Double Suction Pumps bring you these and many more economies because they combine superior hydraulic design with the finest quality workmanship and materials.

Lower maintenance cost and fewer expensive time-outs are the result of these "Buffalo" construction features: sturdy, machined casing with ample, simply-formed water passages — hydraulically balanced impellers assuring peak efficiency — renewable bronze wearing rings — heavy-duty ball bearings and shaft is high grade steel, machined all over, bronze covered, or solid monel metal or other alloy.

Lowest possible service costs are assured by the extra accessibility designed into these pumps. Horizontally-divided casing permits quick removal of the upper half. Thus interior parts can easily be inspected or removed without disturbing pipe connections.

Add to these economies peak efficiency and dependability and you have a pump that is unsurpassed for the most severe industrial clear water service.

For full information on the "Buffalo" Double Suction Pump, contact your nearby "Buffalo" engineering representative. Or write for Bulletin 955-S.



BUFFALO PUMPS

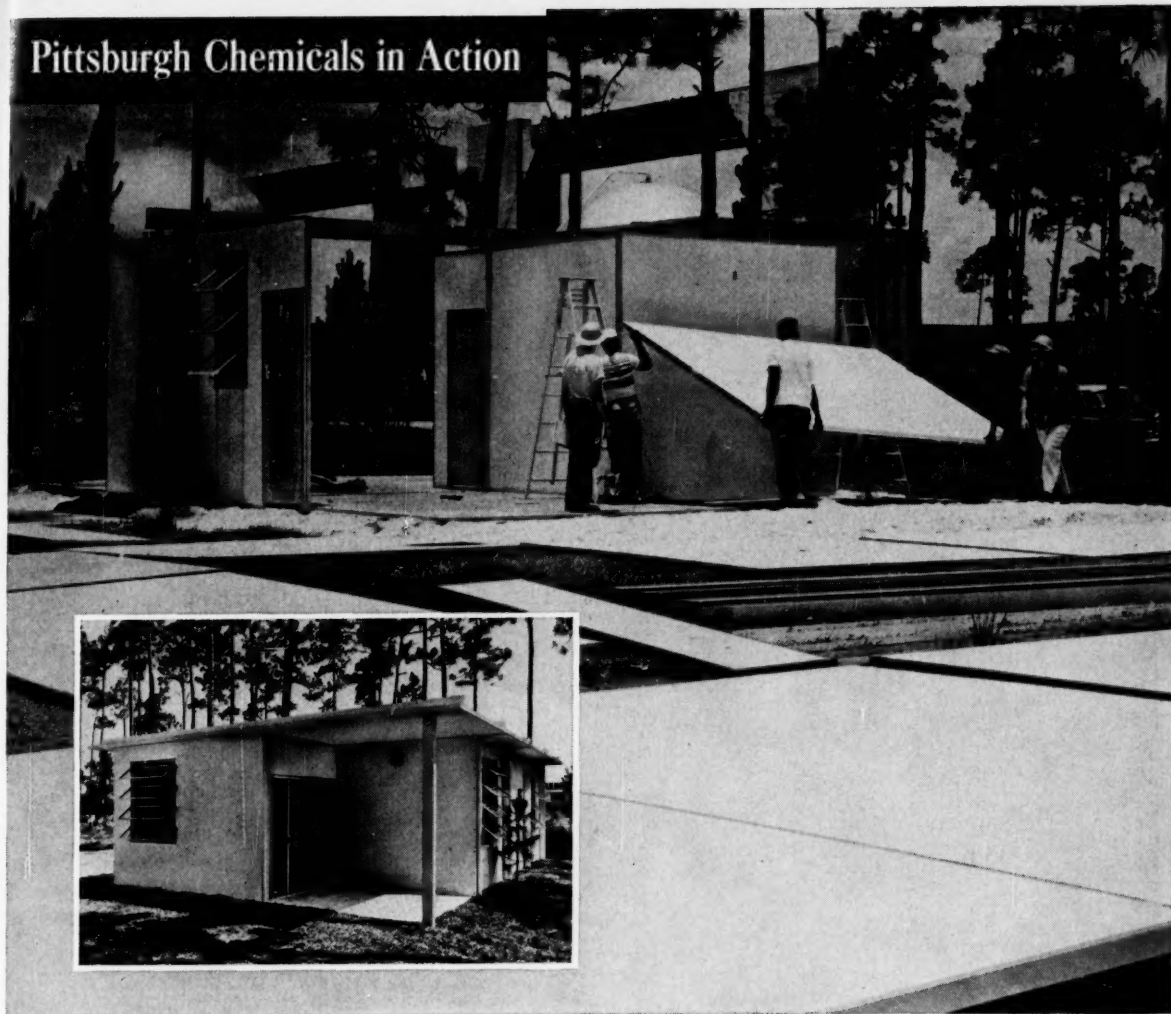
Division of Buffalo Forge Co.

501 BROADWAY • BUFFALO, N. Y.

Canada Pumps, Ltd., Kitchener, Ont. • Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Pittsburgh Chemicals in Action



Five Men Erected This \$2,500 Polyester Home in 5 Hours!

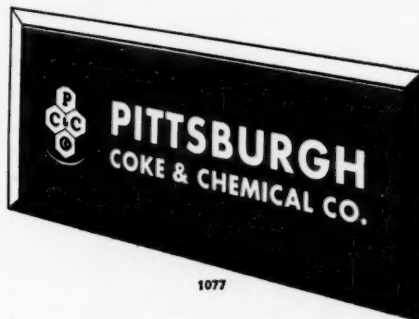
PLASTIC homes and buildings! It's a fabulous plastics market that moves nearer reality as America's building supply manufacturers develop plastic construction panels like the polyester-faced units above. And a growing number of polyester resin manufacturers are relying on Pittsburgh Coke for dependable supplies of high purity maleic anhydride, phthalic anhydride and fumaric acid—three key chemicals used in the production of polyester resins.

The dwelling above is a forerunner in the field. It was pre-fabricated principally from plastic foam panels faced with glass-reinforced polyester sheets. These high strength, lightweight panels rival any conventional materials in weather resistance, ease-of-unkeep and insulating qualities.

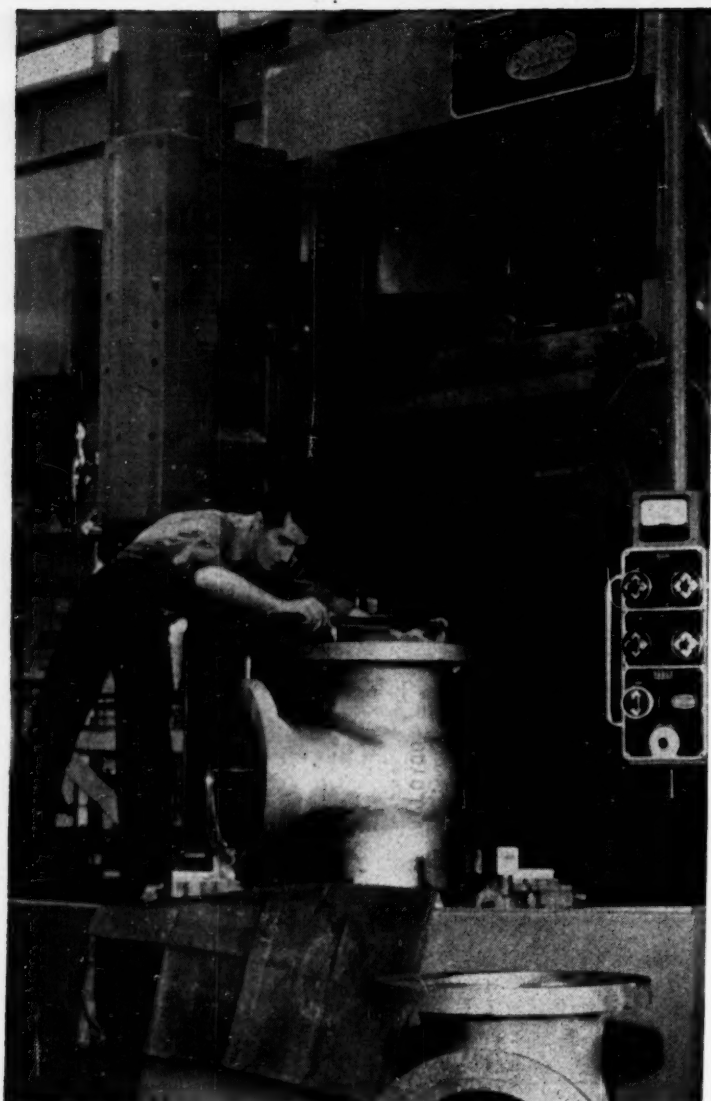
Interior partitions, made with honeycomb cores faced with colorful, translucent polyester, are finding growing architectural use, too.

If you make polyester resins, you'll save time

and money buying "all three" intermediates from Pittsburgh. Paper work and shipping costs can be reduced . . . and you'll be dealing with one efficient, coordinated sales and technical service team, anxious to meet your delivery requirements and help reduce your processing costs. Call Pittsburgh for your next shipment of intermediates!



COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON • FERROMANGANESE



14" 300 lb. gate valve slated for a large petro-chemical plant, is being worked on one of Aloyco's battery of new Bullards.

Advanced machines... tools...test facilities expand Aloyco Valves' range of service

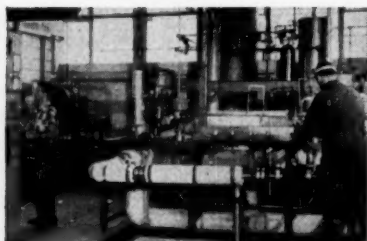
Constant change and improved techniques in modern fluid handling, pose a real challenge for valve manufacturers.

To meet these demands, Aloyco is constantly adding new facilities, some of which are pictured here.

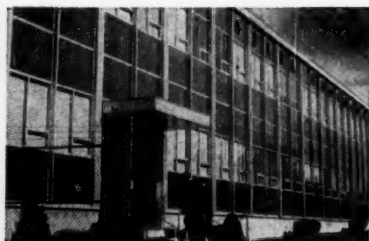
For example, Aloyco Stainless Steel Valves are now available in sizes up to 24", pressures up to 2,500 lbs. at 650°F.

While these new facilities have improved and expanded the quality and usefulness of our entire line, they are particularly important, for example, in the manufacture of valves for the nuclear and missile fields.

For advanced knowledge and ideas plus the equipment to carry them out—take your next valve problem to the specialists: Alloy Steel Products Company, 1301 West Elizabeth Avenue, Linden, New Jersey.



One of finest hot test loops in the nation checks out valves at up to 2500 psi, 650°F. Hot tests can spot trouble that would otherwise be revealed only after months of line service.



New multimillion dollar Aloyco plant combines new production tools, test facilities, sales, administration, research and development offices and labs into single integrated unit.

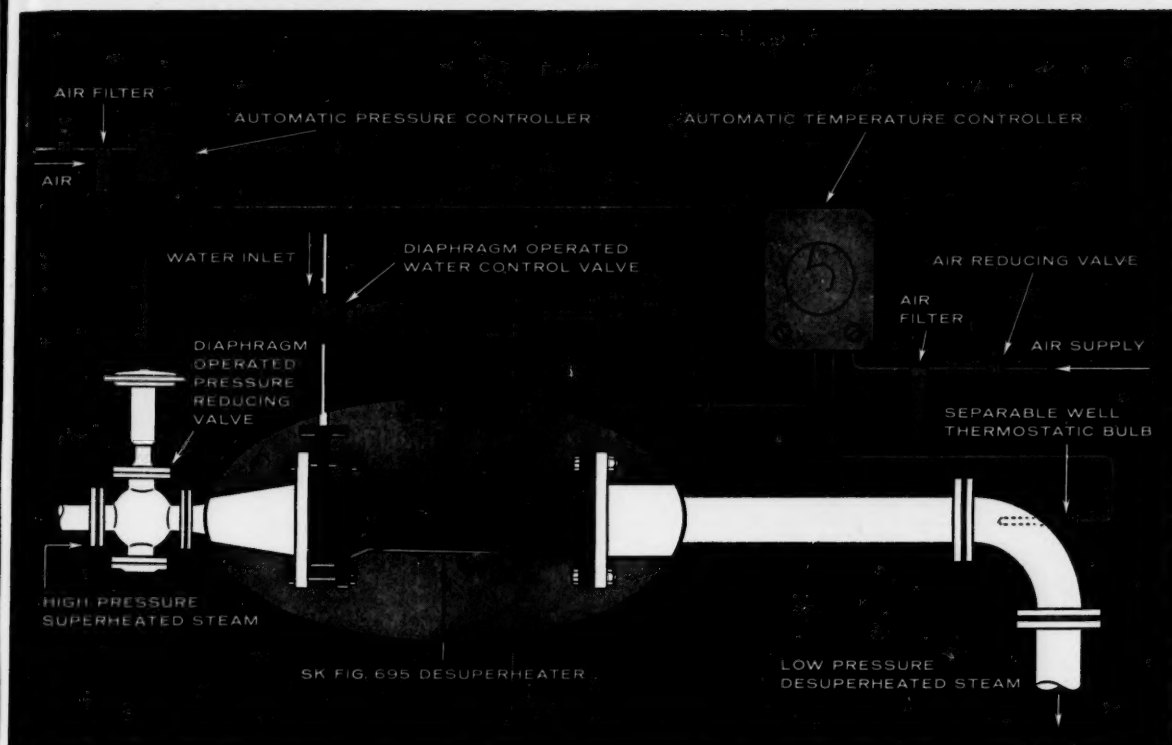


Boroscope examination (in pressurized clean room) of specially made nuclear valves follows the application of dye penetrant.

ALLOY STEEL PRODUCTS COMPANY LINDEN, NEW JERSEY

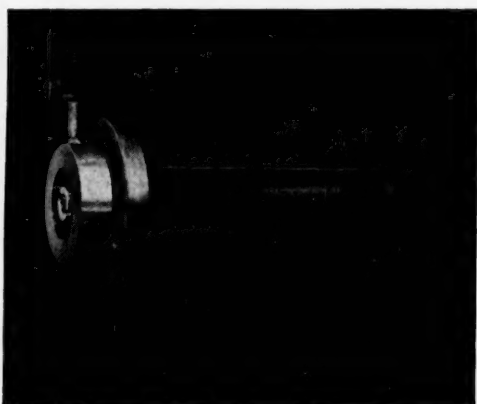
Boston • New York • Wilmington • Atlanta • Birmingham • Baton Rouge • Buffalo
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Reduce Steam Temperature for Process Operations *with this light, easily-controlled Desuperheater*

SK Fig. 695 Venturi Type Desuperheater. An important feature of this desuperheater is the fact that the water need not be at higher pressure than the steam entering the desuperheater. As noted in description, right, water can enter the unit at inlet steam pressure.



The SK Venturi Type Desuperheater, shown in the illustrations above and at left, is designed to reduce the temperature of superheated steam to the lower temperatures required for use in process operations and for operating plant auxiliaries.

These Desuperheaters are light in weight and small in dimensions—are supported directly by the superheated steam line. In addition, they are simple in construction, provide straight-through flow with only a small pressure drop. Because these units are designed for application with automatic control, they are particularly well suited for process and petroleum plants where steam flow varies. They can, however, be used without controls where steam flow is steady. In such cases only a separator need be added.

The Venturi Type Desuperheater reduces steam temperature by bringing water into contact with the superheated steam. The water pressure is low since it need only equal the operating steam pressure. The water is preheated in the chamber around the water diffuser and issues, through many small jets, into the steam stream. Since the steam-water mixture is discharged through the desuperheater outlet in a fog-like condition, without contacting the side-walls, maximum desuperheating effectiveness is obtained and minimum wear occurs in the discharge piping.

The particular desuperheater shown is one of four types made by SK for process plants. Complete details on all types are contained in Bulletin 6D. Write for a copy.

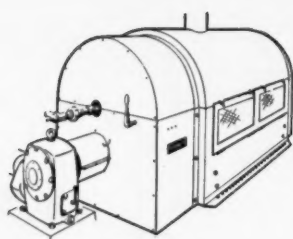
JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
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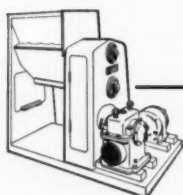
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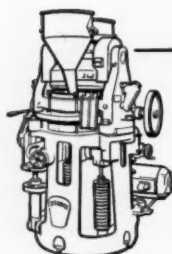
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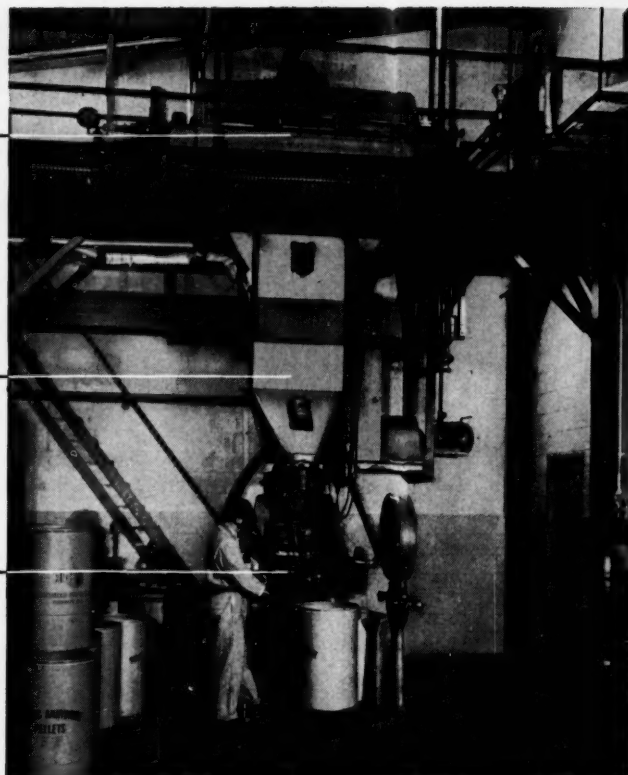
①



②



③



STOKES FLAKER leads "triple play" production at Reichhold

Maleic anhydride pellets are produced in a continuous operation... from Stokes flaker-to-granulator-to-tabletter... at a rate of 1200 lbs. per hour.

Reichhold Chemicals, Inc. has simplified the processing of a difficult-to-handle material with the installation of this Stokes designed processing system. At the company's Elizabeth, N.J. plant, liquid maleic anhydride is pumped from storage tanks into a Stokes drum flaker mounted on a platform directly above a Stokes tabletting machine. A Stokes oscillating granulator is suspended in between.

Continuous Flow—After freezing the liquid and converting it into a solid, the flaker delivers the material directly to the granulator which, in turn, feeds the tabletting machine. This "triple play" production line

takes advantage of gravity flow and eliminates intermediate handling—exceptionally important because of the corrosive and hygroscopic nature of maleic anhydride, and the fume problem it presents.

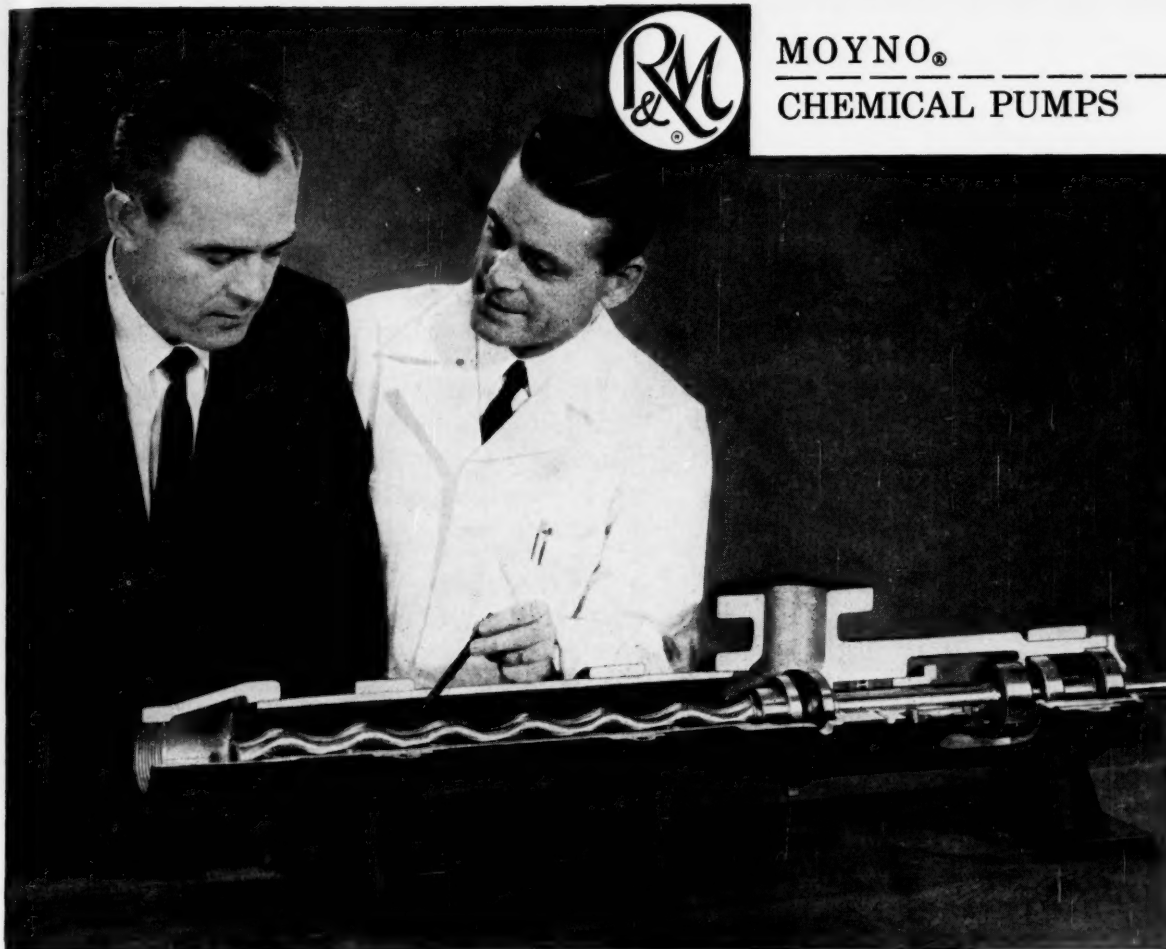
Flexibility for unusual problems like this is one of the features you can count on in all Stokes processing equipment... including drum flakers and dryers, rotary and conical vacuum dryers, vacuum shelf dryers, granulators, Tornado® mills, single punch and rotary tabletting machines, vacuum ovens and furnaces, vacuum pumps and a wide range of related equipment. You can count on top performance and economy too, because Stokes design is based on over 50 years of close association with the chemical process industries. Our Laboratory and Advisory Service can help you on special problems. Write or call for full information.

Processing Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES



MOYNO®
CHEMICAL PUMPS



MOYNO. Progressing Cavity Pumps Handle Chemicals that *Ruin Other Pumps!*

MOYNO's unique "progressing cavity" principle and special resistant internal parts slash pump maintenance costs on problem chemicals that ruin other pumps. Any chemical that can be forced through a pipe—from thin watery slurry to extremely viscous rubber dough—can be pumped with a Moyno.

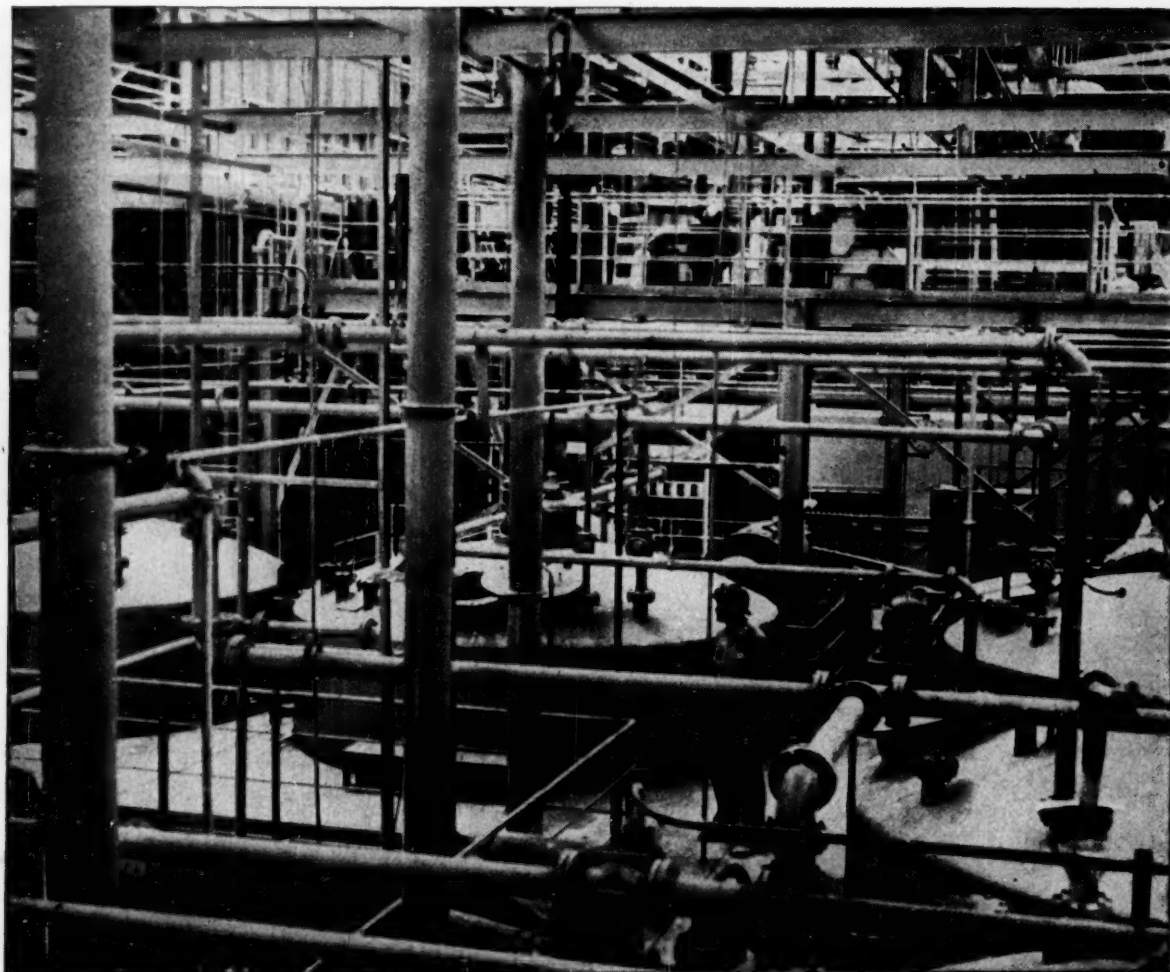
As illustrated at right and in the cutaway model above, a rugged screw-like rotor turning inside a double-threaded stator forms "progressing cavities" which move chemicals smoothly. Fluids are pumped without turbulence, agitation or pulsation, and discharged uniformly. Rotor and stator materials resist abrasion and corrosion. Hundreds of difficult chemicals successfully handled prove that MOYNOS show little wear, even after long service. They have increased production and greatly lowered downtime on many jobs where they replaced other type pumps which had run up prohibitive maintenance costs or failed completely. On other jobs, MOYNOS have succeeded where chemicals were formerly moved by hand or other expensive means because they were considered unpumpable.

MOYNOS are available in capacities up to 500 gpm; pressures up to 1000 psi. Off-the-shelf replacement parts are always immediately available. To find out how you can decrease chemical pumping costs, write today for Bulletin 40 CE



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motors, household fans, Propellair industrial fans, hoists, Moyno industrial pumps
SPRINGFIELD, OHIO • BRANTFORD, ONTARIO

DOW**SARAN LINED PIPE****Saran Lined Pipe . . .****process lifeline with a hot acid cargo**

When a complex piping system carries corrosive process liquors . . . when it must withstand constant thermal stress imposed by its high-temperature cargo . . . corrosion resistance and high physical strength are the keys to pipeline dependability.

The maze above is of Saran Lined Pipe, and is a part of the process piping at American Cyanamid's Savannah plant, Savannah, Georgia. Most of this pipe carries process liquors with a sulfuric acid content of 25% . . . at temperatures of 165° F. and above. Pumping pressures range upward to a maximum of 70 psig.

The chemical activity and high temperatures of the pipe's contents are severe threats to pipeline durability, but thanks to the extreme corrosion resistance and high strength of Saran Lined Pipe it has performed dependably for Amer-

ican Cyanamid since installation four years ago.

Similar sections of Saran Lined Pipe carry hydrochloric acid in concentrations as high as 37%, while others are used to transfer 10% caustic soda. In many areas other types of corrosion resistant piping have been replaced with new Saran Lined Pipe, with highly satisfactory results.

When processing systems require piping that must resist corrosion and chemical activity, under a wide variety of conditions, consider dependable Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Department 2280AK1-25.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

U.S.I. CHEMICAL NEWS

Jan. ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1960

U.S.I.-International Formed To Serve Markets for U.S.I. Polyethylene Abroad

A new European company has been formed by National Distillers (U.S.I.'s parent corporation) to handle the overseas sales of PETROTHENE® polyethylene resins, and to provide technical service and help in developing markets to customers for polyethylene. The new unit will be called U.S. Industrial Chemicals Co. — International, Division of Sales and Development Company of National Distillers and Chemical Corporation—(International) S.A. Temporary headquarters were opened in September at Kirchenstrasse 13, Zug 1, Switzerland. Permanent headquarters and laboratories will be constructed in Baar, Canton of Zug.

A customer service laboratory will be an integral part of the new company. It will be completely equipped with processing and test equipment designed to meet European standards and operating conditions. The laboratory will be used to demonstrate processing techniques and for research and evaluation studies to help its customers develop new end-use markets and produce improved products. The laboratory will also include polymer testing equipment to insure product quality. The laboratory will service markets in the European countries, including the United Kingdom. Mr. Howard W. Woodham is the Manager of the new Technical Service Laboratory.

Sales Manager of U.S.I.—International is Mr. Kenneth E. Cosslett, who has been U.S.I.'s Assistant Export Manager. According to Mr. Cosslett, U.S.I.—International's PETROTHENE resin sales will be made through established representatives in European countries. The new company will be a supporting unit to help these representatives provide the close technical assistance which the polyethylene market demands.



Woodham



Cosslett

Ruthenocene and Osmocene Found to Have Aromatic Character, Like Ferrocene

Two more organometallic compounds are reported to behave like aromatics, although the compounds from which they are derived are completely nonaromatic. In this re-

MORE

Methionine Stressed for Cosmetic and Pharmaceutical Use

New Developments Summarized and Current Applications

Reviewed in Paper Given at TGA Meeting

At the December meeting of the Scientific section of the Toilet Goods Association in New York, Dr. Harry J. Prebluda of U.S.I. and Dr. Irwin Lubowe of the

New York Medical College spoke on the growing uses of methionine in drug and cosmetic formulations. Methionine is an essential amino acid containing sulfur.

Increased knowledge of methionine's reactions and functions in the living organism has stimulated a considerable amount of interest in the compound. Clinical studies following up on basic biochemical research have pointed to new uses for synthetic DL-methionine in pharmaceuticals and cosmetics. U.S.I. has been a pioneer in the development and use of synthetic DL-methionine by the animal feed and pharmaceutical industries.

Topical Applications

Clinical trials have been conducted with methionine and its derivatives in the topical treatment of various cutaneous diseases with great success. Data on the rate and extent of methionine absorption through the skin indicates nearly half the efficiency of oral feeding. This means that some of the polyfunctional properties of methionine can be utilized by formulators of cosmetics, toiletries and topically applied medications. Commercial preparations containing DL-methionine along with other ingredients for topical use are presently appearing in this country and abroad. Aerosol sprays are also being explored.

A therapeutic compress containing methionine has been formulated which has proven very effective in the early treatment of infectious and eczematous dermatitis. There have been several favorable reports on the value of methionine for wound healing in protein depleted animals and humans.

MORE

World's largest zirconium ingot, 13,200 lbs., gets surface examination at Niles, Ohio, plant of Mallory-Sharon Metals Corporation (owned one-third by U.S.I.). Ingot was melted from zirconium chunklets produced by company's exclusive sodium reduction process. Melting of giant 30-inch ingot is regarded as significant achievement, since cost of strip and sheet products is directly affected by ingot size.

Polyurethane Foam Now Used in Bone Surgery

According to recent reports, surgeons can now "glue" broken bones, permitting patients to move a fractured limb while it is healing. Polyurethane foam is the material used, and it has already been tested successfully in hundreds of cases of serious fracture demanding reduction by surgery.

The foam is prepared right at the operating table from sterilized prepolymer and activator, then poured into place by the surgeon. It hardens rapidly, and the patient can move the limb within a few hours. Patients have walked on broken legs so treated in two to seven days after surgery.

The polyurethane foam is quickly replaced by new bone which grows through and around it. No toxic reaction has been reported.

New Data Sheet on Caustic Soda Just Issued by U.S.I.

Specifications, properties, applications and shipping information for caustic soda are detailed in a new data sheet now available from U.S.I.

The material, which U.S.I. ships as commercial grade 50% liquid in tankcars, tank trucks and barges from two plants at Huntsville, Alabama, is used primarily in the manufacture of chemicals, rayon and film, pulp and paper, petroleum derivatives, cleansers, textiles and soap.

The data sheet can be obtained from U.S.I. sales offices or from the Chlorine and Caustic Soda Sales Department, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N.Y.

Jan.

★

U.S.I. CHEMICAL NEWS

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1960

CONTINUED

Methionine

Oral Use

Many cases of chronic peptic ulcer have been treated with methionine, with good clinical healing results in 80% of the patients. The addition of methionine to infant oral formulas is effective for clearing up cases of diaper rash. Similarly, methionine has been used orally for urine odor control with older patients in hospitals and other institutions. Methionine intake at high levels has been used in the treatment of stubborn urinary tract infections. Stable chemical reaction products from organic acids and methionine derivatives have been prepared which show clinical promise for a series of non-toxic wide-spectrum urinary antiseptics.

Methionine has been used in formulations for treating coronary artery disease in humans. The material also seems to protect biological systems against natural or nuclear radiation. More recently, methionine has been tried in the treatment of schizophrenia in a European psychiatric clinic with excellent results. American workers have already started to explore the possibilities of using methionine by itself or in combination with recognized tranquilizers for the treatment of mental disease and emotional depression brought about by impaired nitrogen metabolism.

The technical presentation before the TGA was documented with 48 references. Reprints can be obtained from U.S.I. on request.

CONTINUED

Organo-metallics

spect they are like ferrocene (dicyclopentadienyliron) which appears to have aromatic reactivity although it is derived from non-aromatic cyclopentadiene.

The materials are ruthenocene (dicyclopentadienylruthenium) and osmocene (dicyclopentadienylosmium), prepared from ruthenium trichloride and osmium tetrachloride plus cyclopentadienylsodium which is a reaction product of cyclopentadiene and metallic sodium. Both ruthenocene and osmocene undergo substitution reactions that are characteristically aromatic. They react with acyl chlorides in the presence of aluminum chloride in a way typical of aromatic Friedel-Crafts

reactions. They can be metalated with n-butyllithium to give (after carbonation and hydrolysis) mono- and dicarboxylic acids.

Because all of these metallocenes participate in the Friedel-Craft reaction, it has been possible to prepare novel compounds containing two different metals—ferrocenyl ruthenocenyl ketone, for example.

New Polyethylene-Lined Drums Designed to Ship Liquid Chemicals

A new type of polyethylene-lined drum now available to the chemical industry has an outer pack which consists of wood members reinforced with double-dipped, galvanized steel binding wires and staples. This exterior is said to be corrosion-resistant, and to make the drums lighter, more durable and less expensive than the usual combinations of steel and polyethylene.

The drums have passed MCA-ICC tests for regulated liquids, and can now be used for any liquid safe in polyethylene. This includes corrosive, inflammable and toxic materials.

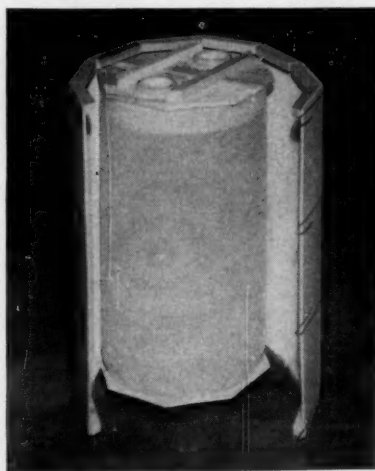


Photo courtesy Delaware Barrel & Drum Co.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Amino-acid resins—a series of ion-exchange resins specially prepared for separation and analysis of amino acids—are now on market. Available in two types for use with fraction collectors or amino-acid analyzers **No. 1550**

Plastics safety handbook now being sold is first such volume devoted entirely to safety ever to be published for plastics processing industry. Many industry processes are specifically treated, giving latest safety methods. **No. 1551**

New portable hydrocarbon detector gives rapid analysis of total organically bonded carbons in gases, with sensitivity better than 0.1 ppm. Can monitor air pollution or lower explosive limits, detect leaks or impurities in systems. **No. 1552**

New catalog offers reprints of technical journals and books long out of print but in great demand. Reprints are reproduced in book form by offset process, and are sold both paper-bound and cloth-bound. **No. 1553**

Mobile vacuum system can now be obtained which is claimed to produce any desired moderate vacuum (250 mm to 0.5 mm) and hold it within ± 0.2 mm, in an airtight system. Plugs into any 115-volt, 60-cycle, a-c outlet. **No. 1554**

For painting and decorating polyethylene, new flexible lacquer has been developed. Said to be durable, chip-proof; will not come off with handling. No special treatment of polyethylene needed to make lacquer adhere, it is claimed. **No. 1555**

Measurement of chlorine-in-air in concentrations from $\frac{1}{2}$ to 20 ppm can now be accomplished with new field detector kit. Employs aspirator bulb to draw samples across detector tube of silica gel. Reaction yields blue stain on gel. **No. 1556**

English translations of Crystallography, a bi-monthly publication of the USSR Academy of Sciences, can now be purchased. Offers experimental and theoretical papers on crystal structure, growth, and other phases of the subject. **No. 1557**

PTH (3-phenyl-thiohydantoin)s derivatives of amino acids being offered as tools in protein and peptide structure determinations. Used as standards and for comparisons when applying Edman method to study of protein structures. **No. 1558**

New automatic recording vacuum balance can weigh samples in air or inert gases, at atmospheric or reduced pressures, at room or higher temperatures, on balance pan or suspended below balance in a furnace. **No. 1559**

PRODUCTS OF U.S.I.

Alcohols: Ethyl (pure and all denatured formulas); Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL®M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fuel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide.

PETROTHENE® . . . Polyethylene Resins

Animal Feed Products: DL-Methionine, MOREA® Premix (to authorized mixer-distributors).



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The sentinel that never gets relief... Day after day after day, for over 4 years this Beckman oxygen analyzer has maintained vigil on catalyst regeneration. Located eight stories above The Texas Company refinery at Wilmington, California, it has monitored unreacted oxygen, under demanding conditions, with only minimum routine maintenance. Analysis must be continuous, dependable, accurate. ☒ This Beckman instrument is the only oxygen analyzer to use a direct paramagnetic measurement exclusively, which brings you these advantages: *Dependability...* under the most rugged conditions. *Simplicity...* with no auxiliary measurements to complicate analysis, no extra components requiring extra maintenance. *Accuracy...* with sensitivity and specificity to meet the most critical process requirements. ☒ Whatever your application, if you want detailed specifications on an oxygen analyzer that withstands tough environments and gives you continuous, dependable answers ask for Data File 14-5-08

Beckman

Scientific and Process Instruments Division

Beckman Instruments, Inc.

2500 Fullerton Road, Fullerton, California

It's a Fact: A Beckman Infrared Analyzer has successfully controlled heat input to a refining tower for three years, maximizing ethylene recovery and minimizing methane content by analysis of the bottoms of a demethanizing absorber.

BULK HANDLING PROBLEMS SOLVED:

the **EFFICIENCY** of "automation" **+** the **FLEXIBILITY** of unit containers **=**

TOTE



SYSTEM

Compare Tote—a complete, mechanical, automatic bulk handling system based on metal containers plus filling and discharging equipment—with a "push-button" fixed storage bin system. You'll find that Tote offers the advantages you want:

- Compact storage
- Surge capacity between processing and packaging operations
- Accurate and automatic weighing and blending

The labor cost of operating a Tote System is no greater, while the *installation cost of a Tote System is much less.*

IN ADDITION, Tote System retains the flexibility of unit containers:

- *Flexibility in Transportation:* Tote Bins can be shipped by rail or truck, or they can be retained in the plant and filled from bulk hopper cars or trucks.
- *Flexibility in Plant Layout and Procedures:* Tote System can be adapted easily to future requirements. Plant layouts can be changed simply by re-locating discharge stations. Operations can be expanded merely by procuring additional Bins. And the Bins can be used interchangeably for different products.

Why not let our engineers survey your plant at no obligation? Meanwhile, write for new catalog containing complete details.

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International's MgO
has the purity others
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Disappointed with conventional magnesium oxides? Then try International's. *It's the only MgO produced by thermal decomposition.* And the difference is amazing! Electrically furnaceed, this MgO has achieved the highest resistivity and refractory properties of any commercially available magnesium oxide.

You'll find International MgO relatively low in cost. Now improved production facilities are geared to produce any quantity you need.

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Here's how IMC does it!

CONVENTIONAL PROCESSES

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Magnesium Chloride $MgCl_2$
(Contained in sea water,
well brine, bittern.)

+
Lime CaO
(Contained in dolomite,
sea shells, etc.)

↓
Magnesium Hydroxide $Mg(OH)_2$ + heat

↓
Magnesium Oxide MgO

INTERNATIONAL'S UNPARALLELED PROCESS

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Magnesium Chloride
 $MgCl_2$ + heat

↓
Magnesium Oxide + Hydrochloric Acid
 MgO HCl

↓
heat → MgO

And here's the result!

MgO	99.5%	Cl	0.03	Density	75 lbs./cu. ft.
SiO_2	Nil	CaO	0.05	Low Boron, too,	
SO_4	0.03	Fe_2O_3	0.05	upon request!	

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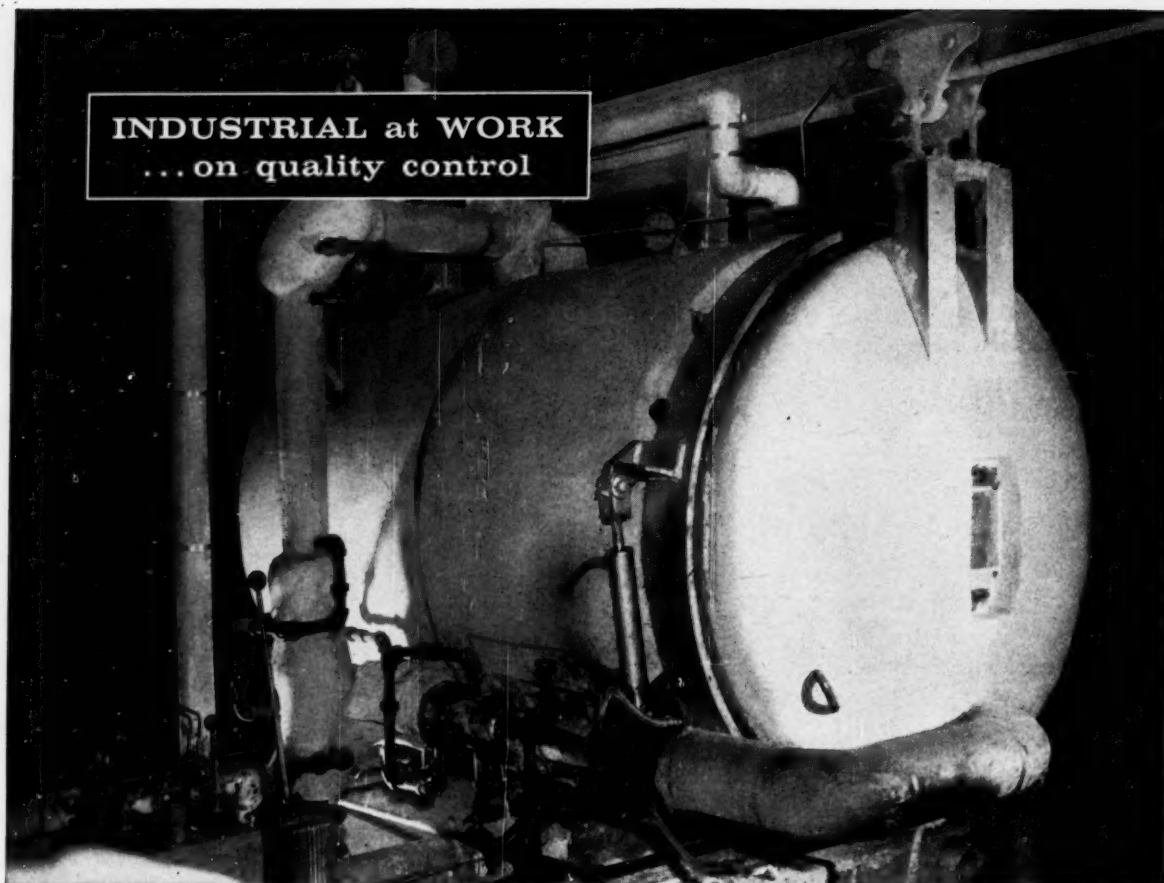
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41-59

INDUSTRIAL at WORK
... on quality control



How STAUFFER CHEMICAL modernization pays off in improved sulphur quality

Improved sulphur quality and an increase in purification production were Stauffer Chemical's aims in a recent modernization program at their Chester, Pennsylvania operation.

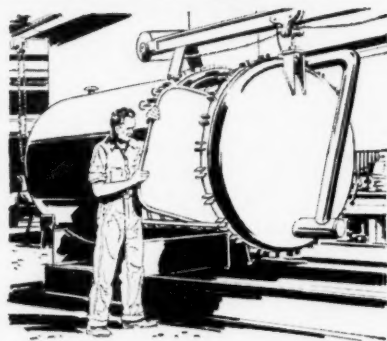
Playing an important role in these now realized goals was this type 122 *Industrial* horizontal filter. Here's how it helped Stauffer to:

IMPROVE QUALITY. Hand skimming of settled carbon from open troughs has been eliminated, permitting major improvements in quality control and optimum carbon removal through filter.

SPEED PURIFICATION. The *Industrial* filter is designed to handle both ash and carbon in one automatic operation. Raw sulphur is melted, purified and then pumped directly to processing.

In addition, the *Industrial* filter operation occupies less space because with settling eliminated—so is their need for tertiary tanks.

The *Stauffer modernization story* is typical of how quality-conscious processors throughout industry are turning to *Industrial*-engineered systems to help meet their customer requirements for more, but *better*, products . . . through controlled filtration.



Industrial's "lift out" leaves speed screen replacement and give easy access for filter maintenance. At Stauffer Chemical Company, extra-heavy bolted leaf construction and hydraulic leaf extractor automate operation.

WRITE FOR
BULLETIN 122



INDUSTRIAL FILTER & PUMP MFG. CO.
5918 Ogden Avenue, Cicero 50, Illinois

INDUSTRIAL

C379

zero plus

**... and Carlson
special stainless steels
withstand the extremes
of another launching**

WHEN this missile "lifts off," Carlson special stainless steel plates help launch it into space. These plates are the high strength, precipitation-hardening grades. And there are sound reasons why these grades are used.

First, with Armco 17-4PH, 17-7PH and PH15-7 Mo* it is easier to attain the high physical properties and resistance to elevated temperatures required in space flight engineering. Simplified low temperature heat treatment will develop a Rockwell hardness of C40 to C50. Tensile strengths, so vital in missile components, range from 180,000 to 220,000 psi in plates.

Second, only Carlson produces these Armco grades in the heavier plate thicknesses. For applications where high strength at high temperatures and ease of fabrication are important, get plates in these grades from Carlson. We will be glad to work with you on specific applications.

*17-4PH, 17-7PH and PH15-7 Mo are
trade marks of Armco Steel Corporation

G.O. CARLSON Inc.

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FLANGES • FORGINGS • BARS and SHEETS (No. 1 Finish)

Photo of Atlas missile courtesy
CONVAIR ASTRONAUTICS,
A Division of General Dynamics Corp.





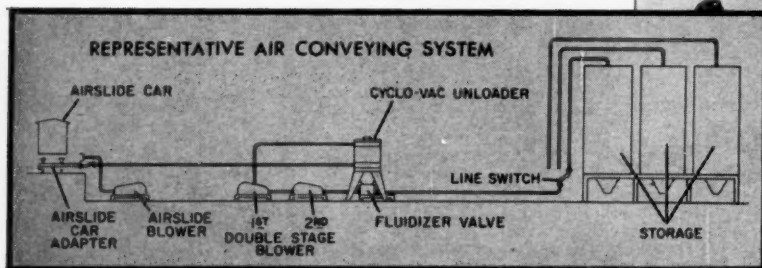
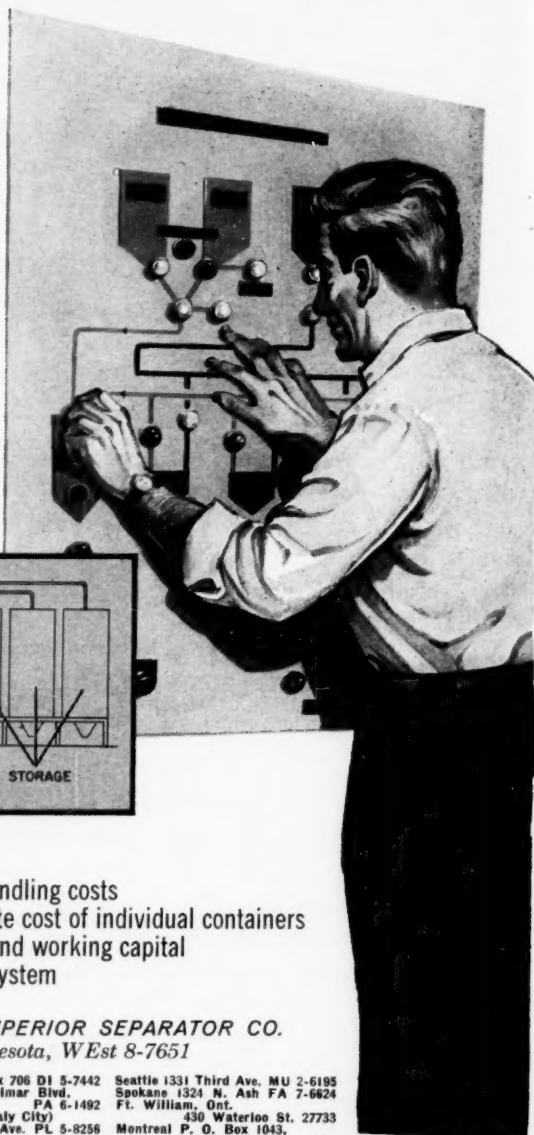
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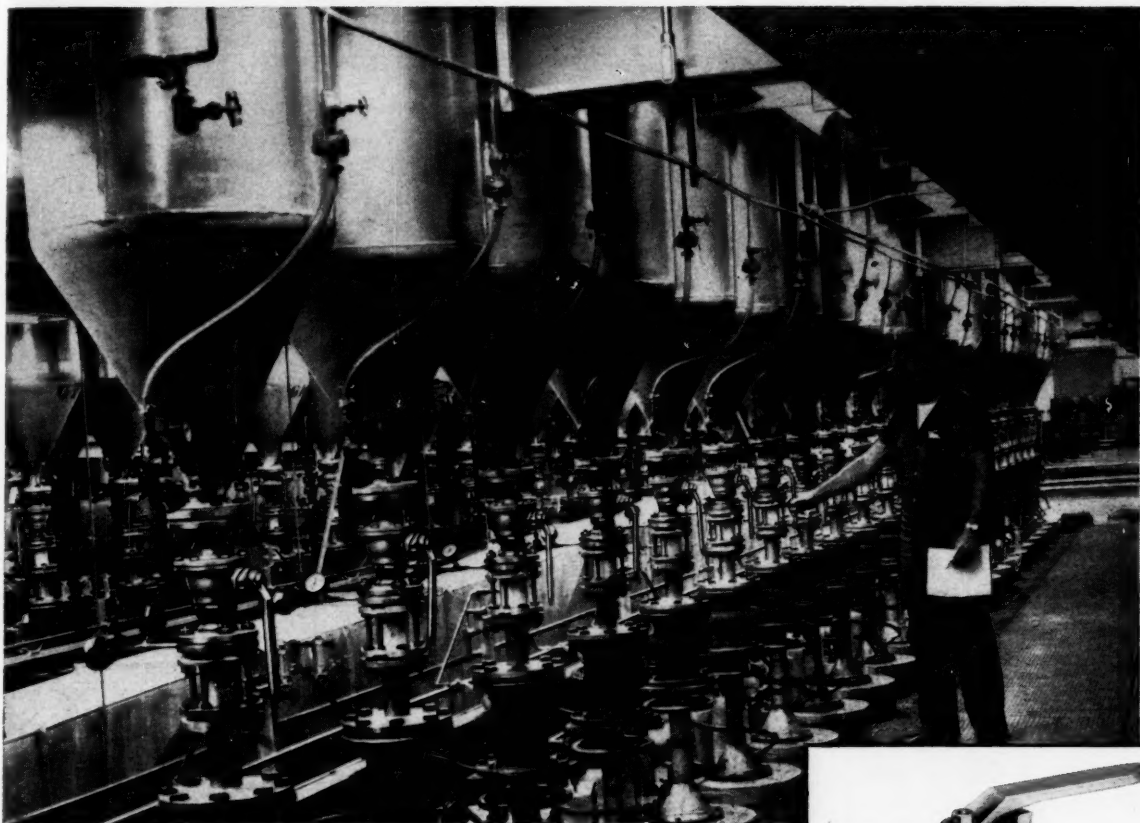
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They broke up the pellet traffic jam...



with Rockwood Ball Valves

A costly and recurrent problem in a large southern synthetic fibre mill was the jamming of polymer pellets as they came from supply hoppers. Source of the trouble was the tapered-throat design of the valves. Even with valves fully open, pellets piled up. In addition, this packing-in action caused severe abrasion on the valves. The problem was solved by replacement with Rockwood Ball Valves. Their *straight-through-opening* feature now permits pellet to flow smoothly . . . and the wear problem has been automatically eliminated because Rockwood valves offer no more resistance to flow than the pipeline itself.

What's more, after hundreds of openings and closings Rockwood Ball Valves still provide *positive leak-proof*

shut-off means. A retainer spring, which *automatically compensates for pressure variations* keeps the seat snug against the ball and holds tight even under vacuum.

Thousands of Rockwood Ball Valves are giving efficient service and cutting costs throughout industry — in oil refineries, textile mills, paper, chemical and rubber plants.

There are types and sizes to meet every requirement in *your* plant. Write today for the illustrated folder on Rockwood Ball Valves. Tested and listed by Underwriters' Laboratories, Inc. Rockwood Sprinkler Company, A Division of The Gamewell Company, 267 Harlow Street, Worcester 5, Mass. Distributors in principal industrial areas.

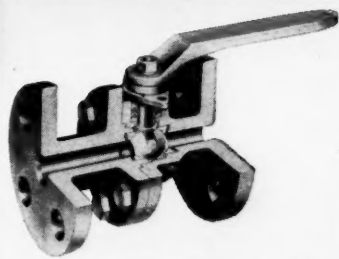


Fig. 254 Type 316 Stainless Steel

Rockwood Ball Valves are available in pipe sizes $\frac{3}{8}$ " through 16" in screwed ends 150 lb. and 300 lb. flanges. All internal parts are of Type 316 stainless steel with spring-compensated TEFLON* seats. Recommended for 600 p.s.i. working pressure and suitable for temperatures ranging from -100° F. to 400° F. All sizes are available with two retainer springs and two Teflon seats.

*DuPont Reg. T. M.

ROCKWOOD BALL VALVES

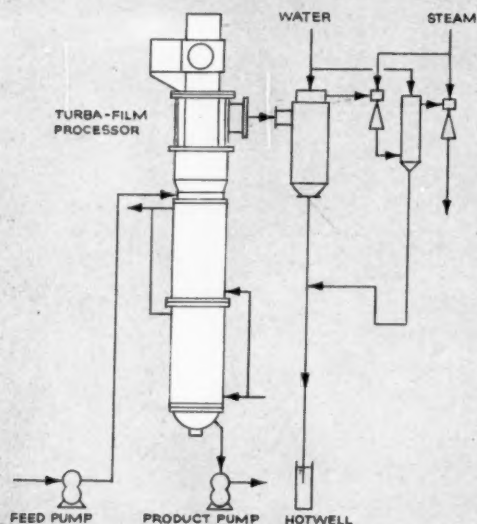


**RODNEY
HUNT**

FLUID PROCESSING

RODNEY HUNT MACHINE CO., Process Equipment Division, 10 VALE STREET, ORANGE, MASS.

RODNEY HUNT PROCESSORS CAN SIMPLIFY EVEN VERY DIFFICULT PROCESSING PROBLEMS



Many process industries have found that the Rodney Hunt Turba-Film Processor can supply simplified solutions to even the most difficult processing problems. And Turba-Film Processors have proved to be extremely versatile not only in the range of industries and products they serve, but also in the different kinds of processes they perform. The units assure closely controlled uniformity of product in processes such as—concentration . . . deaeration . . . distillation . . . steam distillation . . . deodorization . . . liquisols . . . desolventization . . . and homogenization. The flow chart at the left illustrates a typical process combining vaporization with HOMOGENIZATION.

Maintaining homogeneity is often as important as it is to vaporize a diluent or carrier. In the dehydration of latex from 30% to 62% solids, the Turba-Film Processor redisperses the latex to retain a creamy suspension with a viscosity of 5000 centipoises.

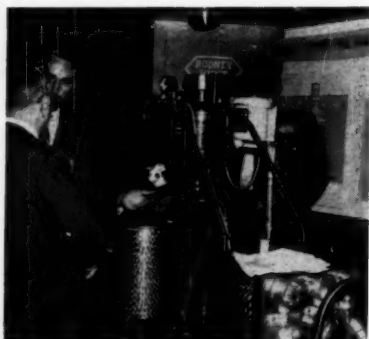
In any process, the Turba-Film Processor assures effective *quality control*, since relatively small amounts of product are in process at any given moment, and the condition of the product can be checked continuously and controlled instantly. In addition, the Turba-Film Processor offers a number of cost-cutting advantages, including simplified installation, minimized cleaning, flexibility of use, and minimum floor space.

THE 1960 CHEM SHOW WAS AGAIN BIGGER AND BETTER THAN EVER

When the 27th Exposition of Chemical Industries at the New York Coliseum shut down on December 4, a total of 35,953 chemical-minded visitors had registered. In the Rodney Hunt booth, we were happy to greet a lot of old friends and to meet many others that we hope will become friends.

In our exhibit we displayed a Turba-Film Processor, and were pleased to see some of our customers for this processing unit who expressed their continuing satisfaction with its efficient and profitable production.

The photograph below shows a group of visitors watching a demonstration of the new Rodney Hunt Pressure Filter, a unit that is still undergoing application evaluations in the Rodney Hunt Laboratory.

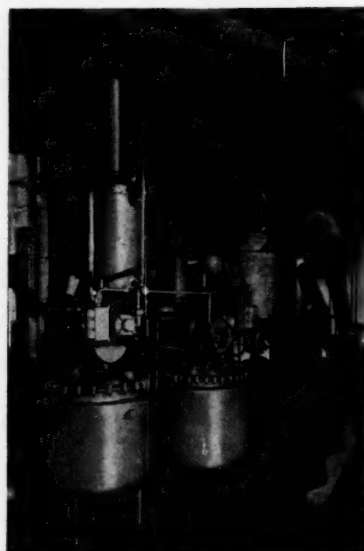


FOR A COMPLETE 24-PAGE BULLETIN PRESENTING THE STORY
OF THE DESIGN, APPLICATION AND OPERATION OF THE RODNEY
HUNT TURBA-FILM PROCESSOR, WRITE FOR BULLETIN 117.

HOFFMAN-LA ROCHE ADDS ANOTHER TURBA-FILM PROCESSOR

The well-known pharmaceutical manufacturer, Hoffman-La Roche, has been using Rodney Hunt Turba-Film Processors to concentrate dissolved heat-sensitive substances since 1954. Within the past year additional equipment, including a larger Turba-Film Processor, has been installed for the improvement of manufacturing processes at their plant in Nutley, New Jersey.

In reference to the earlier installation, the company has stated: "We have been using several Rodney Hunt Turba-Film Processors for the concentration of solutions containing heat-sensitive pharmaceutical products. Due to their special design, the Turba-Film Processors show excellent performance and are superior to conventional evaporators. Evaporation takes place rapidly with only brief contact of the heat-sensitive material with the heating area. Exposure to heat also is more uniform than in other evaporator designs, due to forced circulation in the form of an even film of liquid. Decomposition through overheating is avoided and the quality of the product, therefore, is excellent."



DEVELOPMENTS ...

JANUARY 25, 1960

Chementator

T. PETER FORBATH

Leading auto makers reportedly have picked seat covers made of polypropylene yarn for their 1961 models. Some 1960 cars, to be manufactured later this year, also will be so equipped.

Plans of Columbia Gulf Transmission to use jet engine to power natural gas compressor station at Clementville, Ky., have received Federal Power Commission approval (Chementator, Oct. 5, p. 37). Facility is to be completed by this summer.

Du Pont has entered rocket field. Company has teamed with space-veteran North American Aviation in a joint R&D program to develop liquid rocket propellants.

New coke processes tap western coal

Determined efforts to give the mountain states (e.g., Utah, Montana, Wyoming) a much-needed native source of metallurgical-grade coke by carbonizing those states' vast supplies of low-value bituminous coals are beginning to show some commercial results.

- Food Machinery & Chemical has started building a \$3.5-million plant at Kemmerer, Wyo., to convert soft coals to high-grade coke using a "revolutionary" process.

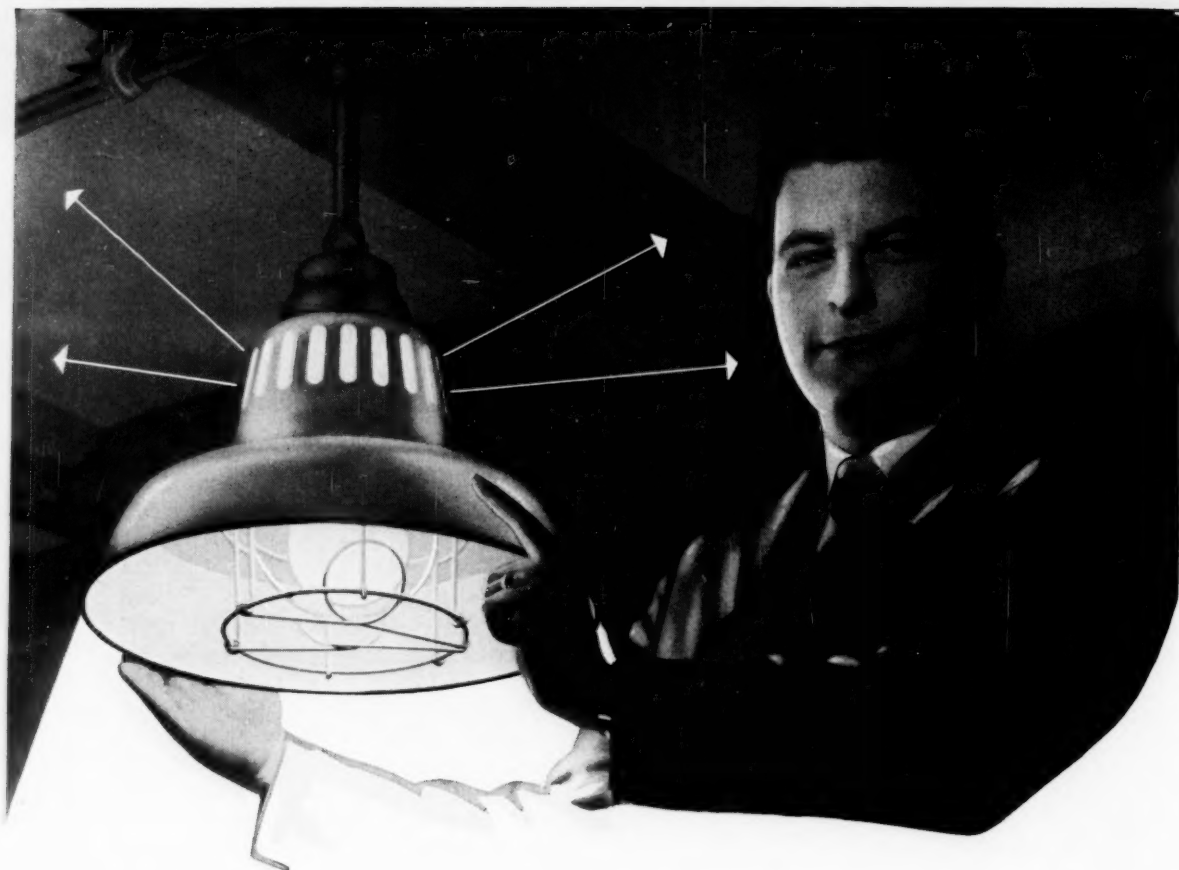
- United States Fuel Co. (Salt Lake City) reports it has piloted a new process for coking Utah soft coals, now plans a \$250,000, 50-ton/day plant and visualizes building a \$2-million, 100,000-ton/yr. facility.

Though details of FMC's process haven't been disclosed, company notes significantly that plant won't produce any coal tars, oils or gases. In flowsheet, coal is first reduced to a semi-coke, then briquetted without use of binder and converted to product of 3-in.-dia. size for blast-furnace use and of 7/8-in.-dia. size for phosphorus-furnace use.

U.S. Fuel first pelletizes coal fines with inert binder and water. Pellets are dried, preheated to 600 F., then charged to natural-gas-fired fluid-bed coking retort running at 2,350 F. In this flowsheet, about 45-50 gal. of coal tars and oils, and 18,000-25,000 cu. ft. of gas are produced per ton of coal.

FMC and U.S. Fuel are shooting at target that no other company has succeeded in hitting commercially to date—that of (1) putting to work the mountain states' huge soft-coal reserves and (2) providing those states with a local source of metallurgical-grade coke which now must be imported by the area's growing phosphorus, steel and non-ferrous metals industries from Midwest, South, Canada and other distant points.

Koal Krudes, Inc. (Spokane, Wash.) had a near miss with a \$300,000 coal-carbonization plant at Red Lodge, Mont. (*Chem. Eng.*, July 1956, p. 138). That facility was intended



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Explosion-proof—Type EV,
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in slotted dome or angle
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FOR COMPLETE INFORMATION on all Crouse-Hinds lighting fixtures equipped with the new slotted reflectors, call your nearest Crouse-Hinds distributor, or write us.



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to turn out 100,000 tons/yr. of char from soft coals. But company ran out of funds just before startup in 1958.

Another try: Husky Oil and Union Pacific have joined in a venture in which Union plans to build a \$3-million carbonization plant at Rock Springs, Wyo., feeding on soft coal available on Union's railroad rights-of-way. But this project has bogged down over federal legislation that restricts use of coal from railroad rights-of-way.

Coming: Boost for plastics in building

Long-heralded but still-pending invasion by plastics of the home-construction market may finally be getting a boost on something like the scale it needs. Plastics manufacturers, who've been hopefully priming the pump with experimental houses using plastic construction materials, now will have a complete experimental housing development in which to demonstrate the efficacy of their wares.

Action-Housing, Inc., a privately supported Pittsburgh civic agency, has bought 130 acres of land in Pittsburgh, plans to build 1,680 dwellings there using the most advanced housing concepts. And this week the organization is holding a meeting at which companies such as Alcoa, Koppers, Pittsburgh Plate Glass, Dow, U.S. Steel, Westinghouse and Jones & Laughlin are getting a chance to suggest new building materials for use in the project.

Koppers is proposing use of its Dylite-expandable-polystyrene-foam core panels, for example. Molded as a single unit to both interior and exterior wall finishes, foam in these units provides both insulation and structural strength. Dow and Alcoa, too, are suggesting foam core panels, aluminum-faced in Alcoa's case.

Action's project, in addition to its total objective of demonstrating better living through new concepts in residential planning, design and construction, will come to grips with the major barrier between the plastics industry and the construction market—construction codes. Often multiple, conflicting and outmoded, these codes—indicted at a recent MCA meeting as one of the biggest enemies to plastics' entry into home construction—will be waived for the project. Too, the development should provide the biggest educational showcase to date of available plas-

tics and their properties for architects and builders.

Currently, plastics account for only 2% of the total \$15-billion building materials market. That's about 12% of the \$2.5-billion sales of plastics in 1959.

New processes cast mixer as reactor

A Swiss machine with a long and honored history as a mixer now takes on the role of a reactor in four new processes being put up for licensing in the U.S. and Canada. The well-established Ko-Kneader, developed by Buss AG of Basle, Switzerland (*Chem. Eng.*, June 1954, p. 223), serves as the key reaction stage in new routes to hydrofluoric acid, acetylene, aluminum fluoride and synthetic cryolite engineered by the Swiss firm and now available on this side of the Atlantic from Vulcan-Cincinnati.

Reports Vulcan, unit's well-recognized feature of providing exceptionally intimate and uniform mixing can be turned to the task of reacting with high efficiency stoichiometric proportions of solid materials with very high yields. This virtue already has attracted commercial interest to the Buss-Vulcan flowsheets. Dixon Chemical Industries has signed with Vulcan for a commercial-scale hydrofluoric acid plant at Paulsboro, N. J. And Pechiney (France) has had a 25-ton/day plant in operation for some time and recently constructed a 50-ton/day unit making hydrofluoric acid.

Ko-Kneader has been eyed before this for use as a reactor. Baker-Perkins, which holds exclusive manufacturing and marketing rights to the Swiss machine in this country and Canada, declares it has engineered a Ko-Kneader for use as a polymerization reactor for an unidentified customer. And Rhodiaceta (France) reportedly has developed a cellulose acetate process in which a Ko-Kneader serves as an acetylation reactor.

Of the four flowsheets that it's offering, Vulcan regards the HF process as the most immediately promising for wide-spread commercialization in a day when HF is finding increasing markets (e.g., rocket fuels). Reacting calcium fluoride and sulfuric acid in a Ko-Kneader, process turns out high-purity product in yields higher than competitive routes, with minimum corrosion problems and

(Continued on page 48)

EXCLUSIVE SAVINGS

at Wallerstein Co.

The Wallerstein Co. of Staten Island, N. Y., one of the nation's largest producers of enzyme chemicals, wanted to produce more sodium isoascorbate more efficiently. This heat sensitive chemical is used as an antioxidant for meat products.

A P-K Vacuum Tumble Dryer solved the problem by tripling output while materials handling time and

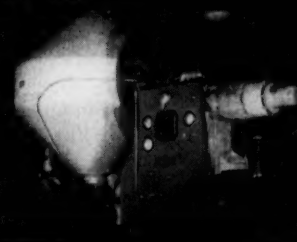
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PRE-TESTED! Future savings in vacuum tumble drying can be previewed at P-K's Vacuum Tumble Dryer Pre-Test Laboratory. Pre-testing realistically points the way to economies in drying time, solvent recovery, process simplification and handling costs. It permits modification of controls, condenser, vapor line and other components to the individual needs of your process and product.



PRE-PACKAGED! Pre-packaging utilizes P-K's knowledge of companion equipment and parts. Units arrive completely assembled, fully balanced and ready for use. This eliminates costly, do-it-yourself trial and error during assembly and installation. It saves engineering time and overhead in every step from design through purchasing and start-up.



EXCLUSIVE COMBINATION!

Only P-K Vacuum Tumble Dryers offer pre-tested, pre-packaged savings. In pre-testing, results are predicted with a detailed procedure report and test samples. In pre-packaging, a single source of responsibility delivers a tailored, thoroughly proved assembly at a cost far less than a do-it-yourself project.

Compared to tray drying, the advantages of P-K Vacuum Tumble Dryers are overwhelming. Drying is many times faster. Expensive solvents are condensed and

recovered. And caking that requires separate pulverizing and screening is eliminated. This greatly reduces handling and it safeguards against product contamination. It often saves enough in labor costs alone to justify investment.

Why not investigate the packaged P-K Vacuum Tumble Dryers more completely? We would also welcome an opportunity to conduct pre-tests of your materials in our Liquid-Solids Blenders*. Our pre-test facilities are at your disposal. Just call George Sweitzer, Stroudsburg (Code Area 717), Hamilton 1-7500, or write our East Stroudsburg Headquarters, 1511 Hanson Street.

* patented

with P-K Vacuum Tumble Dryers

effort were cut 75% — a substantial cost reduction.

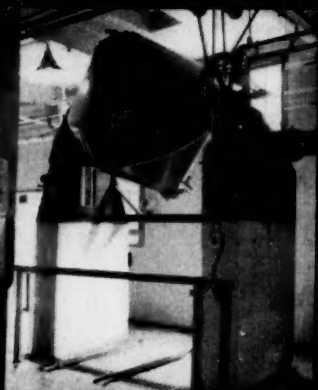
The P-K Dryer replaced a rotary barrel type unit, upping production from 800 lbs. per batch to 2,400 lbs.

Materials handling time and effort were reduced by taking advantage of the P-K dryer's convenient charging and discharging features. The unit is charged from the second floor through one apex of the double

cone (see photos below). The dry powder is discharged directly into storage vessels rolled beneath the unit. The old rotary barrel dryer had to be discharged by hand shoveling.

Liquid content of the product is reduced under vacuum during drying. The condensed liquids are drawn off and reclaimed.

**TRIPLES
CAPACITY**



REDUCES HANDLING BY 75%



predict your savings by pre-testing

Patterson Kelley

Chemical and Process Equipment Division

**PATTERSON KELLEY CO., INC.
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Please send technical literature on P-K Pre-packaged Vacuum Tumble Dryers and details of your offer to pre-test our use of them.

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with a profitably marketable calcium sulfate byproduct, Vulcan maintains.

In acetylene flowsheet, Ko-Kneader serves as reactor for calcium carbide and water, provides almost 100% conversion of reactants. Though most new acetylene plants these days are turning to natural gas for raw material, Vulcan feels this calcium-carbide-based route will find a competitive place in areas lacking cheap natural gas supplies.

Fresh approach to labor disputes

Chemical engineers are watching with undisguised interest the unique "away-from-the-bargaining-table" conferences now going on between Kaiser and the United Steelworkers at Fontana, Calif. Reason: Many feel that these conferences may provide a fresh approach to solving the increasing number and increasing bitterness of labor disputes that have been plaguing the chemical process industries in the last few years.

Involved: Two, year-round, long-range study groups set up jointly by Kaiser and the union after their recent steel-contract settlement. Object: To untangle the problems that are choking labor-industry relations.

First group is on the corporate level, consists of three union leaders, three company officials and three representatives from the public at large (e.g., university professors). Its task: Recommend ways of sharing company's future economic progress equitably among shareholders, employees and the public.

Second group is on the plant level, consists of three members from plant management and three members from plant union. Its task: Find solutions to the specific labor problems arising from automation, technological progress, changing local working conditions, conflicts among various skills.

Telomerization: Route to alcohols?

A process for making higher alcohols and ketones is pressing toward commercialization in Germany though it continues only as a promising laboratory reaction in this country.

Process involves reaction of methanol or acetone with propylene or butylenes via telomerization to give products chiefly in the C_6 - C_{10} range. It takes place at 750-900 psi. and 285 F., uses ditertiary butyl peroxide as catalyst.

Union Rheinische Braunkohlen Kraftstoff AG (Cologne) has this route under development, reports scale-up to pilot plant operations is slated to come in the next few months, to full-scale plant in the not-too-distant future.

Biggest attraction of the process, declares URBK, is the high yield of useful alcohols and ketones produced. Methanol plus propylene gives the following alcohol yields: 62% C_3 - C_{11} ; 28% C_{13} - C_{17} ; 20% C_{19} and higher. Acetone plus propylene gives 51% C_6 - C_9 ketones; 20% C_9 - C_{18} ketones, plus higher polymers.

There's been a good deal of work done with telomerization in the U.S., principally by Esso, Union Carbide and Du Pont. But high consumption and cost of catalyst has been a major stumbling block to commercialization, these companies report.

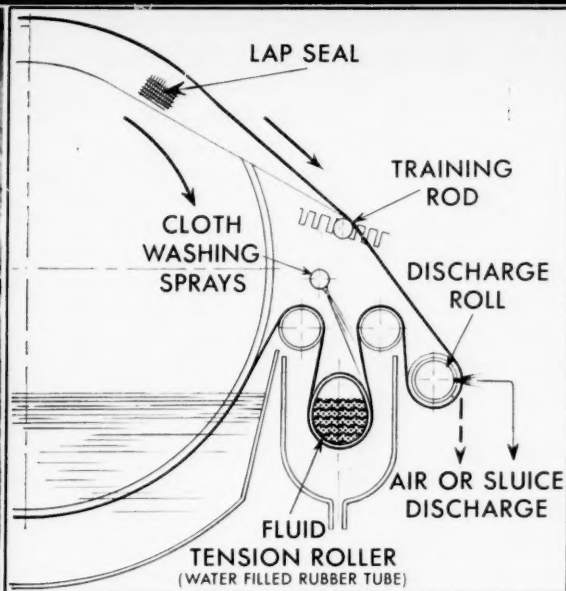
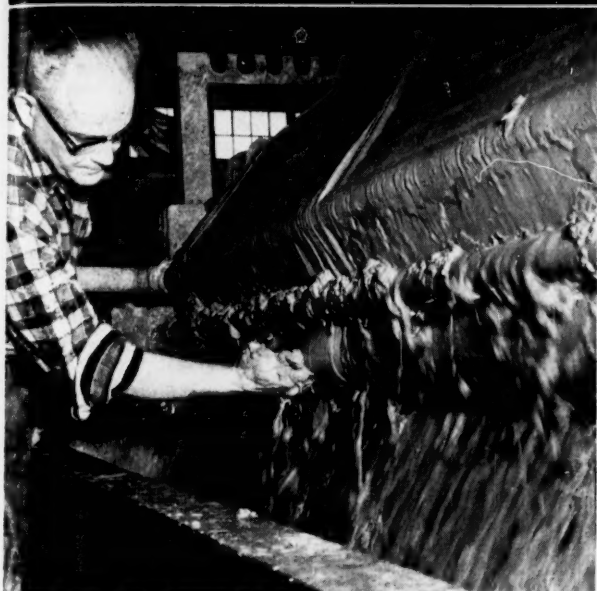
URBK acknowledges that use of di-*t*-butyl peroxide as catalyst does make it doubtful whether or not the telomerization process could economically compete with other alcohol-making routes such as the oxo process or the Zeigler route recently commercialized by Conoco (*Chemtator*, Nov. 16, p. 87). But company indicates that it has come up with another peroxide catalyst that may beat this problem. Possibility: Cumene hydroperoxide, a phenol intermediate.

New processes open way to polyacrolein

Acrolein's exceptional reactivity—always seductive, often a snare to researchers—is offering some new possibilities for commercial exploitation. Two German firms, Farbwerke Hoechst and Degussa, separately have reported development of processes for polymerizing acrolein. Commercial plants are planned, polyacrolein output is slated for use in varnishes, films and other surface protecting materials.

Union Carbide, Shell Chemical, Sohio, Du Pont, among other U.S. firms, have registered a high degree of interest in the German developments, indicate they've been seriously studying polyacrolein in their labs. As yet, however, none acknowledges commercial intentions with the material.

But there are strong signs that the day of commercial polyacrolein production in the U.S. may not be far off. Shell Chemical is completing construction of a 30-million-lb./yr. plant at Norco, La., for making acrolein via propylene oxidation. And though major part



Cloth Loop filled with water is deformed to show "Fluid Tension" Principle Rubber tube filled with water provides "Fluid Tension" on commercial design

NEW CLOTH DISCHARGE FILTER

Water Filled Loop Provides "Fluid Tension" to Solve Cloth Tracking Problem

The new, patented "Cloth Discharger" licensed* by Peterson Filters and Engineering Company completely cleans a fabric medium and prevents cloth creeping and wrinkles. Internal cloth blinding is prevented. Cakes too thin for other filters can be completely discharged without blow back, permitting fast drum cycles. Cloth life is extended because of gentle fluid tension and because there is no scraper abrasion or cutting action from particles held in the threads of the cloth.

TRACKING PROBLEM PREVENTED FILTER APPLICATION . . .

Although these advantages and the applications of such a device are numerous, the problem of cloth tracking has prevented its use. In the past, fixed diameter tension rolls have been tried in various and complicated arrangements, but were unsuccessful because the rigid rollers are not sensitive enough to compensate for the variable stretch in a filter cloth. The cloth would creep rapidly toward the points of least

tension and tracking the cloth onto the drum required either constant attention or delicate impractical guide mechanisms.

COMMERCIAL DESIGN NOW ELIMINATES CLOTH TRACKING PROBLEM . . .

The Cloth Discharger, has solved the problem of rapid lateral creep in the cloth by replacing the rigid tension roller with water, or a water filled rubber tube, which has been termed "Fluid Tension Roller". This "Fluid Tension" quickly compensates for variation in cloth stretch. It is inherently simple, but very sensitive so that virtually each thread of the cloth has the same tension. With

uniform tension, there is only nominal lateral creep. In fact, periodically adjusting a simple training rod during the early stages of a new cloth is the only adjustment required. The cloth discharger provides not only the sluice discharge, but a dry discharge. Also the solution to wash the cloth can be kept separate to recycle or to drain. Solution or air jets directly under the cloth, discharge the cake. The jet action is aided by the small radius of curvature of the discharge roll to give a clean sluice or dry discharge without a scraper. The cloth is joined by a zipper for quick replacement when required. Any suitable cloth can be used.

The Peterson Cloth Discharger can be designed to fit most types and any size drum filter. For information on how this Cloth Discharge Filter with the simple Fluid Tension Roller can be applied to your operation, write:



PETERSON FILTERS

AND ENGINEERING COMPANY

P. O. Box 606 — 1949 South 2nd West St. • Salt Lake City 10, Utah

* U. S. Borax and Chemical Co.

of the acrolein output of this plant will go to produce glycerine, well-founded industry speculation has it that much of the remainder will be used in making polyacrolein.

There have been processing obstacles in the way of commercial polyacrolein production which the Germans seem to have hurdled. Among them: Difficulties in controlling polymerization to produce polymers of useful molecular weight; need to keep polymerization emulsion from becoming alkaline in which state acrolein is explosive.

Hoechst process takes place in aqueous solution of such acids as organic sulfinic and thiosulfuric. Degussa uses a 10% solution of sulfur dioxide in water or a persulfate solution. In both processes, polymers are produced in stable emulsions or suspensions. Temperatures are between 32 and 127 F.; oxygen is excluded. Yields over 70% and molecular weights between 50,000 and 300,000 are claimed for both processes. Polymers are soluble in organic solvents, SO_2 solutions.



Today's embryonic developments which have special significance for chemical engineers

● Semiconductor plastic by radiation

A plastic transistor as good as those made of germanium reportedly has been developed by Soviets' Nobel Prize winner Nikolai Semenov.

Plastic involved: A "new type" based on polyacrylonitrile. Key to its semiconductive property: Radiation bombardment. Claim Russians, plastic becomes as electrically conductive as germanium and silicon through radiation processing, is more stable and can be fabricated more easily than those made of germanium.

CE check of U.S. firms prominent in semiconductor field finds them reluctant to either accept or reject Soviet claims. They point out that organic semiconductors have long been under investigation chiefly because of superior flexibility that organics ultimately might offer for "building in" specific electrical properties. Elemental semiconductors (e.g., silicon, germanium, inter-metallics) are limited by the fixed properties of elements.

It's well known that semiconduction and

photoconduction are common attributes of organic materials containing closed rings of alternating double and single bonds, and of such materials as proteins and technical polymers. For example, National Carbon Co. at Parma, Ohio, is researching use of radiation to give thermoelectric properties to liquid organic compounds. And at Moscow's Eighth Mendeleyev Chemical Congress last spring, Semenov himself disclosed that polymers possessing semiconductive properties had been uncovered.

One of the things that bothers U.S. experts about the Soviet plastic transistor is use of the word "transistor." Unlike semiconductor devices such as diodes and rectifiers, transistors must be made of materials with long "lifetime." Electrons flowing through them mustn't be trapped or neutralized before sufficient electric-current amplification can take place. Plastics have been found to be very deficient in this property.

● Research and development briefs

Radiation processing is used in a new noncatalytic petroleum cracking process reportedly developed by the Russians. Claims USSR Academy of Sciences, radiation cracking route operates at temperatures considerably lower than current cat or thermal crackers, gives yields higher than the best of them. Soviets declare process will be put on commercial basis as soon as technique for decontaminating radioactive cracked products is worked out.

New oil-hunting tool that measures magnetic variations of nuclei of hydrocarbon atoms has been developed jointly by California Standard and Borg Warner researchers. Device, dubbed Nuclear Magnetism Log, detects and differentiates between petroleum, natural gas and water, thus promises to take much of the risk out of oil-well logging. Though price is expected to be high, Standard plans manufacture of instrument soon.

U.S. lab-equipment sales—a reliable barometer of research activity—climbed 15% in 1959 over 1958, Chicago Apparatus Co. reports. In 1960, company predicts sales will be up another 20%. Biggest lab equipment buyers include drug, oil and plastic firms.

For more on DEVELOPMENTS.....52



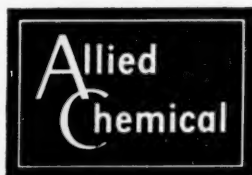
This Advertisement is a NEW PRODUCT "FISHING EXPEDITION"...

Yes, we're fishing! We've developed the new organic fine chemicals which are listed at right. We don't know much about their uses as yet. But we do have limited technical data for each of these compounds, and will be glad to send this to you on request. Also, if you're interested enough to do a little "fishing" of your own, we can let you have sample quantities in most cases.

Commercial production? Not yet. But if enough demand materializes, we can supply these new organics in commercial quantities.

Development of these new organic compounds is another example of the diversified activities of our Baker & Adamson® fine chemicals department. May we suggest—*whenever it comes to fine chemicals, come to Baker & Adamson!*

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GENERAL CHEMICAL DIVISION
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SULFONATE DERIVATIVES

Potassium Acetaldehyde Disulfonate
Methane Trisulfonic Acid
Sulfuryl Fluoride
Sulfur Trioxide-Pyridine Complex
Sulfur Trioxide-Trimethylamine Complex

CHLORINATED COMPOUNDS

Hexachloroacetone
Trichloroacetamide
Trichloroacetdimethylamide
Trichloroacetanilide
Trichloroacetonitrile

OXALIC ACID DERIVATIVES

Oxanilide
Ethyl Oxanilate
Oxalic Esters

PHOSGENE DERIVATIVES

Benzophenone
Benzophenone-4,4'-dicarboxylic acid
Diphenyl Carbonate
Ditolylketone
Di-o-Tolyl Carbonate
Di-n-Tolyl Carbonate
Di-m-Tolyl Carbonate
Di-p-Tolyl Carbonate

In addition, derivatives other than those listed in each category can be investigated and possibly made available.

Seamless Tubing Made From Ductile Vanadium

Seamless vanadium tubing can be made, reports Wolverine Tube Div. of Calumet & Hecla. Key to this advance is the ability to produce vanadium pure enough so that it's ductile. Oregon Metallurgical Corp. worked with Wolverine in developing pure form of the metal.

Extruded vanadium tubing, according to the company, will interest the nuclear and chemical processing industries because of its unusual combination of light weight, high-temperature strength and corrosion resistance. Cost of commercially pure vanadium is currently \$35/lb. but since vanadium oxide is produced as a byproduct of uranium refining it is now in excess supply, thus price reductions can be expected.

New Equations Predict Cracked Product Yields

Revealed at the recent AIChE symposium on catalytic cracking were results of experiments by Sun Oil Co. technical men to find ways to predict quality and yield of cracked products from physical and chemical properties of cat cracking feed stocks.

Use of resulting equations promises to help minimize costly pilot plant evaluations. Equations will also aid selection of crudes by predicting quality of cracked stocks, can be helpful in predicting changes in refinery yield structure when changing cat cracker feed composition.

Equations were derived from pilot plant data on a wide variety of charge stocks by Sun Oil's H. E. Reif, R. F. Kress and J. S. Smith. For predicting quality and yields, significant properties of charge stock are: Mean average boiling point, carbon type

distribution, (aromatics, saturates, naphthenes, paraffins), naphtha in the charge, concentration of total sulfur and basic nitrogen.

Correlation of cracked product distribution against charge stock properties was done by method of linear regression analysis on an IBM 650 computer. Pilot plant studies were done on a moving bed with equilibrium sulfur-resistant clay-type catalyst, using 38 different charge stocks.

To convert calculated product distribution to an alternate catalyst system or other type of cracking unit, specific adjustments would be necessary.

Superfluidity: Key to Plating, Welding Routes?

The phenomenon of "superfluidity" found in molten metals may give rise to strikingly fast, simple and cheap processes for metal plating and welding. So believes Prof. Rintaro Takahashi of the Chiba (Japan) Institute of Technology, who has been experimenting with the idea for the past three years and recently applied for world-wide patents on it. And now he has succeeded in rallying the interest of a group of leading Japanese firms, including big auto- and plane-maker Fuji Heavy Industries, Chiyoda Chemical Engineering & Construction and steel-maker Tokyo Rolling Stock.

Basis of Takahashi's idea: When molten metal is rapidly cooled below its freezing point, rather than solidifying immediately, it becomes an exceptionally fluid liquid for a short period of time. Reason: Supercooling weakens the attraction between metal atoms. Thus, if a drop of molten metal strikes a cool surface, it will first spread swiftly over that surface before solidifying into a coating. This effect, the Japanese professor

maintains, can be used to plate and weld materials.

In a demonstration last month at Fuji Heavy Industries' Tokyo lab, sheet steel was suspended in a sal ammoniac flux and heated to 300 C. A few drops of molten lead dropped on the piece plated it virtually instantaneously on both sides. A similar procedure served to weld two pieces of steel together with equal speed.

Claims Takahashi, any metal or alloy that can be practically melted can be used to plate or weld any solids by this technique. He visualizes it being used to plate steel with tungsten, titanium, beryllium and lead, for example. Too, ceramics could be coated with high-melting-point materials such as zirconium.

Radiation Processing For Compounds

Armour Research Foundation (Chicago) has harnessed radiation to the job of synthesizing fluorine compounds. Reports Paul Feng, supervisor of ARF's chemical-physics research section, aromatic fluorine compounds can be produced by exposing a mixture of aromatic hydrocarbons—e.g., benzene, nitrobenzene—and fluorocarbons to high-energy ionizing radiation from accelerators, X-ray or gamma-ray sources, nuclear reactors.

Work was originally carried out under Air Force sponsorship, now is supported by Army financing. Materials produced are said to be stable, non-flammable and "have good temperature characteristics." They are being studied for use in lubricating hydraulic fluids, plastic materials and in the munitions field. Attraction of the radiation route to the fluorine compounds is one of directness. Notes ARF, conventional chemical syntheses of these compounds require involved substitution reactions.



TREATED glass bags clean hot gas at Bethlehem Pacific, Seattle.

Plants Swing to New Hot-Gas Filters

Many process plants are improving their hot-gas cleaning operations with bag filters that use glass fabric treated to overcome previous shortcomings.

After 10-15 years in limbo, glass-cloth filter bags are in the limelight again for cleaning process gases at temperatures up to 600 F. Only this time, glass cloth is really catching on, thanks to a new treatment which might be dubbed "siliconing for smoothness."

In this treatment, conventional glass cloth is flametreated to burn off starches and sizing, passed through a water emulsion of silicones, and finally heat set at 500-600 F. The resultant fabric is extremely soft, flexible and smooth. Furthermore, it repels water and is far more re-

sistant to mild alkalis and acids than untreated glass fabric.

► **Clean by Flexing**—Few materials stick to the new fabric, so smooth is its surface. And trapped material dislodges easily with gentle flexing—provided, in most installations, by merely collapsing the bags with reverse pressure or suction, or by newly perfected sonic methods. Untreated glass cloth was never widely used because it didn't stand up well under the mechanical shaking action required to clean the filter bags, or to corrosive attack at high temperatures.

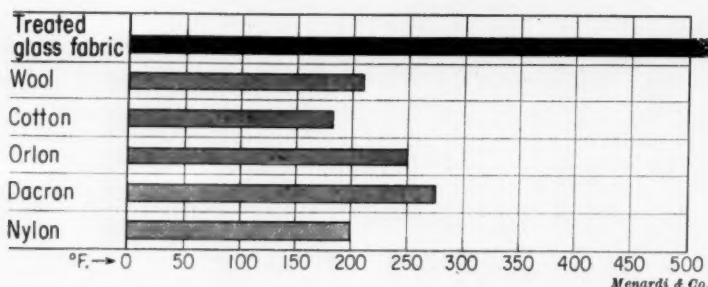
Water repellency of siliconed glass cloth makes for easier drying in the event of condensation of vapor passing through the bag. At Southwestern Portland Cement's Victorville, Calif., plant for example, glass bags which clean waste gases from a wet process kiln become saturated with condensation from time to time. Yet rising temperatures subsequently dry the bags which then discharge readily at the next collapsing cycle and return to normal pressure drop.

► **Used Widely**—Among the many other process plants turning to glass filter bags are: Ideal Cement at Albuquerque, N. M.; Southwestern Portland Cement at El Paso, Tex.; Dragon Cement, Northampton, Pa.; Bethlehem Pacific Coast Steel, Seattle, Wash.; Columbian Carbon at Monroe, La. (carbon black); West End Chemical Div., Stauffer Chemical, Westend, Calif. (borax); Union Carbide Chemicals, South Charleston, W. Va.; Diamond Alkali, Painesville, Ohio; Allentown Portland Cement, Evansville, Pa.

There are still other plants in these and other chemical process industries, including triple superphosphate, gypsum, polyvinyl resins, phosphate rock, soda ash and salt cake.

► **Fills Hot Role**—Siliconed glass cloth enables the operator to double his permissible operating temperatures for glass cleaning—from about 250-275 F., for Orlon and Dacron, to about 600 F. Some processors report being able to handle gases up to 1,000 F. for short

New Fabric Works Above Previous Temperature Limits



periods of time (say, 30 min.) without injuring the fabric.

Gas cleaning at 500-600 F. pays at least two dividends. You reduce the total volume of gas which must be handled by your equipment, reduce it by the amount of diluting air necessary to cool process gases from 500 F. to temperatures at which other fabrics can be used safely e.g. (1.5 volumes of extra air at 100 F.). And you lessen the chance of condensation—with blinding and corrosion—by operating at temperatures far above the dew point of water.

Temperature control is, indeed, most critical. Condensation of oxides of fluorine and sulfur would play hob even with siliconed glass fabric. Most bag-houses are insulated to maintain gas temperatures as high as possible until the gases have passed through the fabric.

On the other hand, cement kiln gases with high alkali-dust contents—thought by many to be incompatible with glass cloth fabrics—haven't blinded or deteriorated new silicone-treated glass bags in 2½ yrs. of operation at one plant.

► **Criteria for Choice**—Let's see what reports from around the country have to say about other factors important in the evaluation of siliconed glass cloth for bag filters.

Cost—generally comparable to synthetic materials in approximately this ratio: cotton, 1.0; Orlon, 2.5; nylon, 2.5; Dacron, 2.5; glass, 3.0. In a cost comparison of electrostatic precipitation and glass bag filtering for one cement plant, the bag unit appeared more eco-

nomical, based on 20-yr. equipment life.

Service Life—a minimum of one year and as much as five years, depending on temperatures and materials involved.

Cloth-to-Gas Ratios—in the range of 1:2 to 1:3.5.

Cleaning—most processors use flexing, deflation-inflation system.* One uses a compressed-air shock wave. Dragon Cement and Allentown Portland Cement clean sonically, a technique which, according to the vendor, can cut pressure drop 25-50% under that for reverse-air cleaning. No report in our hands indicates the need for shaking mechanisms, blow rings, etc., common to most bag-houses.

Pressure Drop—2.5-4.0 in. H₂O.

Efficiency—98-99.9% with particle sizes ranging from sub-micron to 44 microns, depending on the weave of the glass fabric.

Size—at least one 200,000 cfm. unit is in operation now, along with several others rated at 100,000-150,000 cfm. Ideal Cement uses 1,280 glass-cloth bags, each 24-ft. long, 11.5-in. in dia., on rotary kiln gases at its 1-million-bbl./yr. cement plant in New Mexico. Bethlehem Pacific Coast Steel uses 792 bags, each 25-ft. long, about a foot in diameter, to handle waste gases from two 100-ton electric arc furnaces.

* Best reverse-air cleaning practice is to permit the deflated bags to inflate slowly, by virtue of slight leakage of air into each compartment, before putting unit on stream again. This permits free discharge of dust, caught in the collapsed folds of the bag, without the heavy entrainment which would result if the bags were suddenly inflated by the process gas stream.

Manufacturers of siliconed-glass bag filters are even suggesting that because of long bag life and elimination of shaking equipment, their equipment may be justified at temperatures under 500 F.

AICHE Meeting Offers Varied Technical Fare

Last month in San Francisco, the American Institute of Chemical Engineers attracted about 2,000 engineers to its 52nd Annual Meeting. In the three days following the Institute Lecture—DuPont's T. H. Chilton on nitric acid by ammonia oxidation—conferees attended 22 sessions to hear some 110 papers. Some of the highlights of the meeting program:

• GE's Joseph Gaynor, describing three separate coating methods, characterized fluid-bed coating as the most promising development on the coatings application scene. Claimed advantages: no solvents, one-pass application, efficient use of coating material, high coating rate and process economy.

Three coatings methods described included (1) dipping pre-heated object in system of fluidized particles whose melting point is less than object's temperature; (2) covering object with thin tacky coating prior to bed dip; (3) using electrostatics to attract fluidized particles to object.

• Influence of advanced techniques were shown in several sessions on chemical engineering fundamentals, but particularly in sessions devoted to operations research, process dynamics and computer use.

In a session stressing use of computers as a teaching tool, educators and practicing engineers advocated that both analog and digital techniques should be taught in engineering curricula and in company training programs. As if to stress the point, AIChE Machine Computation Committee released the first program for its interchange activity—Line Sizing, prepared for IBM 650 use by Arthur G. McKee & Co.

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FIRST full-scale atomized-suspension reactor goes on stream in Quebec.

New Concept Gets First Tryout

Thermal processing by atomized suspension justifies initial claims in first performance on large scale.

Back in 1955, a promising new process called the "atomized suspension technique" (AST) captured the attention of process engineers (*Chem. Eng.*, Dec. 1955, p. 118). Though in the embryonic stage at that time, AST was characterized as a process that could "open up new vistas for thermal processing"—in evaporation, drying and high temperature reaction.

Now, after modification and refinement, AST reportedly is proving successful in its first full-scale application at Bea-

consfield, Que., a community of 7,000. Here, AST is replacing bacterial digestion for treatment of municipal sewage sludge.

In place of time-consuming bacterial digestion, drying on extensive outdoor beds and subsequent haulage of solids to disposal points, AST handles the operation automatically within a single reactor which, together with auxiliary equipment, occupies only 50 sq. ft.

Of significance to the process industries is that experience

and know-how being gained in the full-scale Beaconsfield installation will prove extremely helpful in design of AST processes for industrial-waste disposal and a host of other applications now in the works.

► **First Dry, Then Burn**—In the Beaconsfield operation, raw-sewage slurry (10% solids) from the process' storage tank first passes through a small disintegrating machine that chops up fibrous particles. The stream then enters the top of a single-shell reactor tower via atomizing pressure nozzles. (Unlike spray drying, no hot gases are introduced into tower with feed.)

Tower wall temperatures, as maintained by four banks of electric heaters, are 1,400 F. at the top and 1,000 F. at the bottom. In larger installations, the reactor would have an outer shell, and hot combustion gases passing through the annulus would supply required heat.

Water in the atomized slurry spray flashes to superheated steam under influence of radiant energy from the high-temperature walls; solids are completely dry before they have fallen halfway down the tower.

Low-pressure air, entering the tower near its middle, then burns solid organic materials to a powdery ash. All bacteria and odors are destroyed.

► **Ash Disposal**—Steam and ash leaving the reactor's bottom pass through a jet condenser. Condensate and entrained ash, relieved of the nitrogen and carbon dioxide burden in a small scrubber, are finally discharged into a nearby river. At present, there is no provision for heat recovery from exhaust reactor steam.

Installed plant cost is \$35,000, which is substantially less than costs for a conventional bacterial digester and drying beds with auxiliary pumps and piping.

Designed, installed and operated by National Welding Co., Ltd., the system will be able to keep pace with Beaconsfield's growth. Ultimate capacity will serve a population of 12,000.

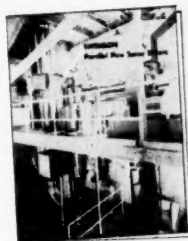
► **Coming Applications**—Canadian and U.S. patents on the process have been granted to inventor W. H. Gauvin; these

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SWENSON



WHITING—MANUFACTURERS OF CRANES; TRAMBEAM HANDLING SYSTEMS; TRACKMOBILES; FOUNDRY AND RAILROAD EQUIPMENT.

have been assigned to Pulp & Paper Research Institute of Canada, which sponsored the research and development projects. Patents are still pending in six other countries.

A number of industrial firms

have investigated the process, and are on the verge of commercially applying it to their operations:

- Stöle Corp. (Sydney, Ohio) is erecting a large atomized suspension unit to handle

cyanides and chromic salts originating from metal-plating operations.

- Green Bay Pulp & Paper Co. of Wisconsin will use atomized suspension for chemical and heat recovery from its neutral sulfite semichemical pulp mill. Designed by Blaw-Knox, the plant awaits choice of corrosion-resistant construction materials for the reactors.

- A mill of Enzo-Gutzeit (Finland) will erect an atomized suspension unit to extract sodium carbonate and sulfur dioxide from kraft liquors leaving conventional evaporators at 55% solids content. Lummus Co. will provide initial design.

- Also, a U.S. chemical firm is proceeding with design and fabrication of a 10-tons/day unit to convert a batch operation to a continuous, one-pass atomized suspension process.

► **Research Under Way**—In addition to the work mentioned above, there are seven experimental reactors under investigation. Three of these are being operated by the Research Institute in Montreal; all are electrically heated.

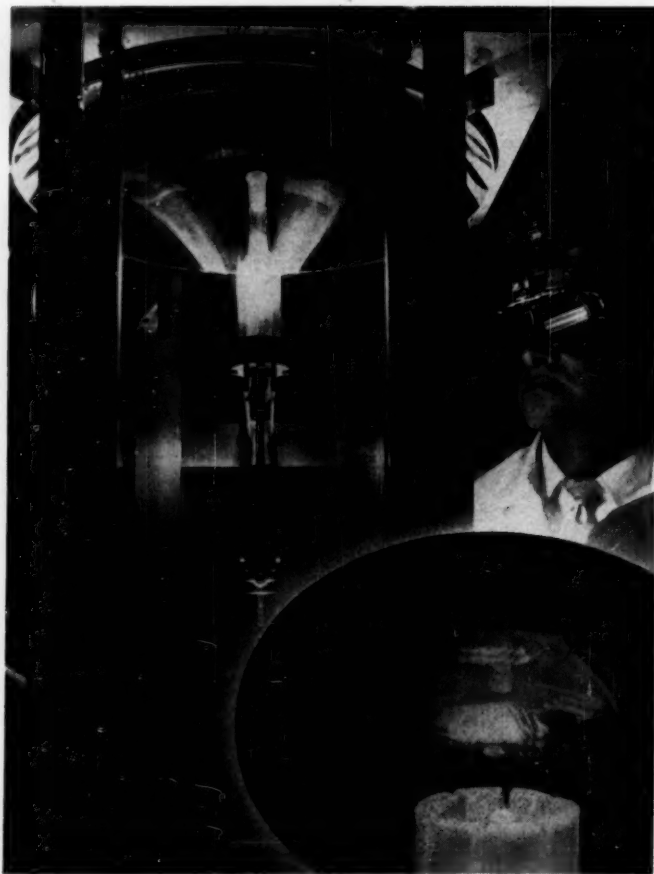
At Leven, Fife, Scotland, two gas-fired units are providing valuable information to Ernest Scott & Co., a design-engineering firm. One reactor is 10 in. by 15 ft.; the other 4 ft. by 5 ft.

And at Hanford, Wash., General Electric is using an electrically heated atomized suspension tower to study and evaluate concentration of radioactive wastes. The seventh pilot plant, a small unit for corrosion tests, has been running for several weeks at Green Bay, Wis.

Two other reactors are currently in the design stage; one will be built by the chemical engineering department of McMaster University, the other by Lummus Co. for installation at its development center in Newark, N. J.

More on Fusion Power: What's in a Name?

From Los Alamos Labs came the word about "entropy trapping" and "picket fences." Then



Arc-Image Furnace Grows High-Purity Single Crystals

Stanford Research Institute has developed a new furnace to grow high-purity single crystals of refractory compounds. Furnace, shown above, consists of two arc units face to face. They are separated by a 45-deg. control mirror which can be rotated to divert light from either of the units to an elliptical mirror

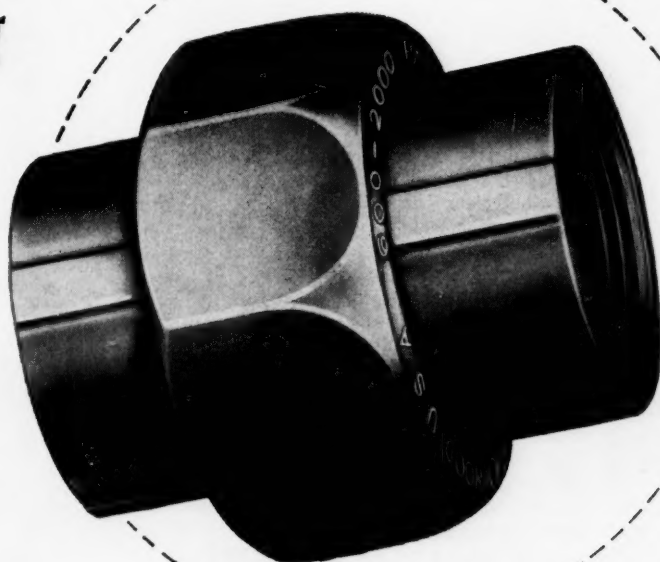
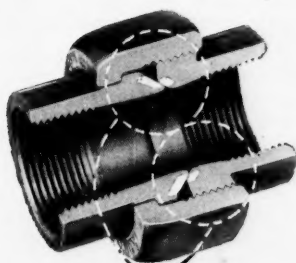
which focuses the energy on top of a growing crystal (see inset, above).

Method has enabled SRI to produce single crystals measuring $\frac{1}{4}$ in. dia., 1-in. long of rutile and magnesium ferrite. SRI is now applying the method to grow carbide, nitride and inter-metallic single crystals.

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swiftly came word from Communist sources about a large "adiabatic trap with magnetic stopper." Comment to *CE* from the U. S.'s Edward Teller: "Fancy names for something that's been around a long time."

Opinions from reliable sources: Entropy trapping and adiabatic trapping are one and the same thing; it's enjoying a renaissance in U. S. experimental work. Fact: U. S., British, Canadian and Russian efforts along this line were discussed at 1958's nuclear congress in Geneva, but the term entropy trapping as such was not used.

A recent article in East Germany's newspaper *Freiheit* reiterates optimistic Russian statements about controlled thermonuclear reactions, connects these with references to Soviet industrial production of deuterium from water and the "adiabatic trap" at Ogra thermonuclear station. But it's not clear just how close the Russians are to controlled fusion.

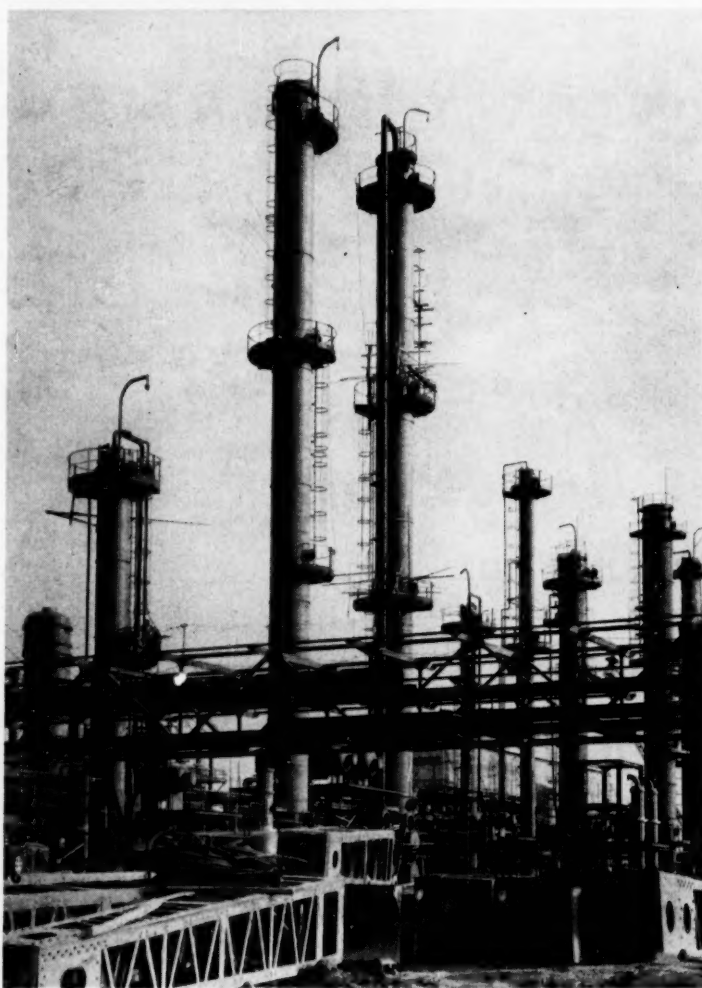
At Los Alamos there now exists a hydromagnetic gun to make plasma and force it into a picket-fence magnet. (See *Chem. Eng.*, Dec. 14, 1959, p. 90.) Present apparatus is not a reactor, will not even make neutrons. It's strictly to observe plasma behavior. Next step is to increase gun supply voltage so that deuterons in plasma get fast enough to make some neutrons.

Another Polypropylene Plant Under Construction

Texas Eastman has firmed up its plans for entry into the booming polypropylene business. Company revealed that construction shortly will be underway on a 20-million-lb./yr. unit at Longview, Tex.

Like its polyethylene, polypropylene will be marketed under the Tenite trademark by Eastman Chemical Products, the marketing arm of parent Eastman Kodak for plastics, synthetic fibers and industrial chemicals. Currently, material is being made and marketed in limited quantities in a pilot plant via Eastman's own process.

INDUSTRY NEWS



JAPANESE synthetic rubber plant is a current Chiyoda project.

Chiyoda Chemical Engineering and Construction Co. is completing construction of its giant \$6-million production plant at Kawasaki. Chiyoda thus increases its capability to meet soaring demand for processing equipment and plants, such as the one shown above: Chiyoda now is swamped with \$111-million worth of inquiries.

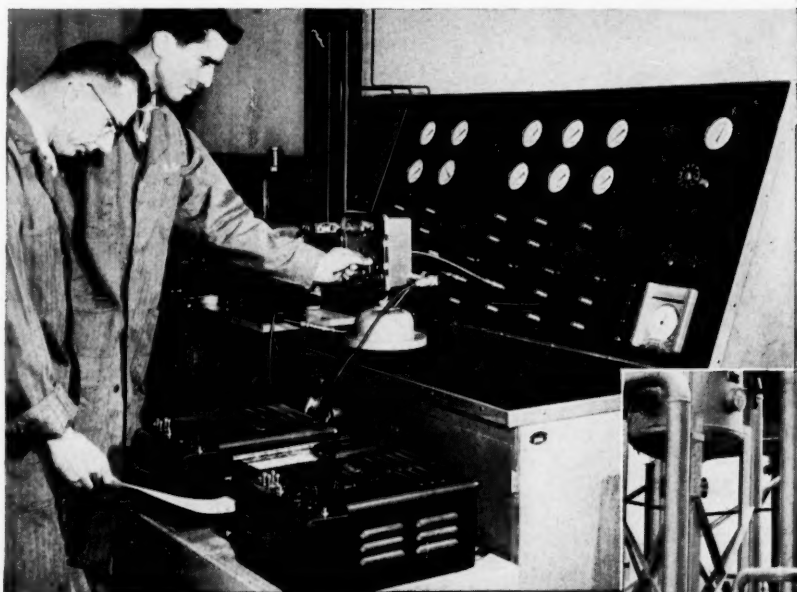
Mobay Chemical Co. plans a third, 3,500-ton/yr. expansion of isocyanate output at Martinsville, W. Va., even before

the current 3,000-ton/yr. expansion is completed. Urethane production, now reaching the 50,000-ton/yr. mark, makes heavy demands on isocyanate producers.

Linde Co. just completed construction of a 50-ton/day air-separation plant at Mobay's Martinsville plant. Medium-purity oxygen output is used

Industry News continues on p. 136.

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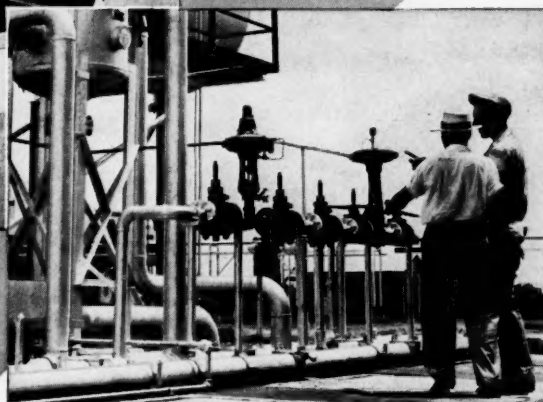


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can't take all the thermal punishment of modern air travel. Chemical fluids will.

Frances Arne, Assistant Editor

It's a far cry from a multi-graded motor oil for the automotive season to the jet-aircraft fluid which must perform both in the congealing cold of a Greenland startup and in the heat of supersonic flight. This vast difference—the reason for our story—is basically the difference between a lubricant or hydraulic fluid that is essentially a mineral product and one that is essentially chemical in nature.

For when an aircraft fluid is expected to function between, say, -65 and 550 F., wholly new materials, as well as skillful formulation, are called for.

► **Petroleum Peak** — The year 1959, in fact, probably marks the ultimate peak consumption of mineral oils in aircraft. This was the year in which chemical-lubricated jet planes reached life size in the commercial airlines picture, the year beyond which no new petroleum-lubricated, piston-engine aircraft will be ordered or built.

How fast mineral oils will go downhill is a matter for conjecture. But their climbing days have been numbered since the early '50s when Esso Research

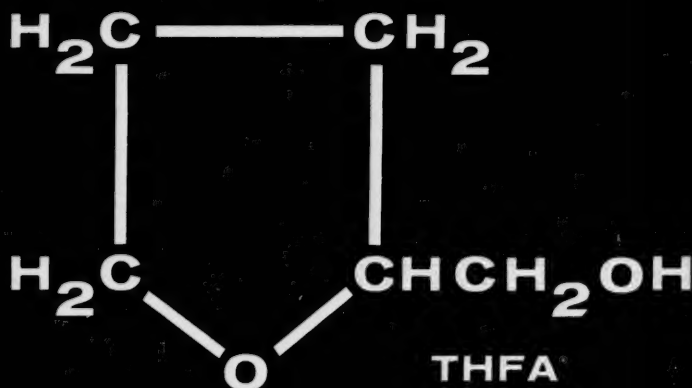
& Engineering's English affiliate pioneered development of synthetic lubricants. These dioctylsebacate-based oils were forerunners of a whole generation of dibasic esters, geared to meet the high-temperature, high-load-carrying needs of the first military jets.

Today's large piston aircraft consume about 30,000 gal./yr./aircraft of mineral oil; world market stands at 25-30 million gal./yr. Commercial consumption of diesters in jets amounts to about 500 gal./yr./aircraft.

For the more advanced jet engines in which diesters can be used, consumption is only about 1/50th that of mineral oils. A military-commercial total of about 2 million gal./yr. is currently consumed. But current diester prices of \$3.50-\$4/gal. are eight to ten times those of mineral oils.

► **Take the Initiative** — With this certainty of a large-scale demand for synthetic turbine oils for aircraft, chemical companies—content in the past to leave the aircraft lubricant market to the petroleum firms and to supply raw materials and additives on

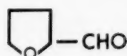




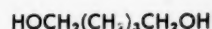
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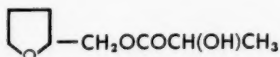
Tetrahydrofurfural



1,5-pentanediol



Tetrahydrofurfuryl lactate



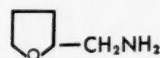
Δ-Valerolactone



Dihydropyran



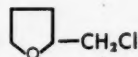
Tetrahydrofurfuryl amine



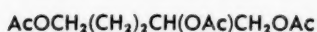
Pyridine



Tetrahydrofurfuryl chloride



1,2,5-triacetoxypentane



Tetrahydrofuran



For more information on the chemistry, physical properties, and uses of QO THFA, write for Bulletin 206.

The Quaker Oats Company

CHEMICALS DIVISION



335B The Merchandise Mart,
Chicago 54, Illinois

Room 535B, 120 Wall St.,
New York 5, N. Y.

Room 435B, 48 S.E. Hawthorne Blvd.
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Swift & Company, Ltd., Sydney

In Japan:

F. Kanematsu & Company, Ltd., Tokyo

request—are taking an active interest in the field. Firms like Union Carbide, Hercules and Rohm & Haas are working on the development of new lubricants.

But chemical companies whose products are accepted may still decide not to sell directly to the aircraft operator, preferring instead to supply intermediate or finished materials to the petroleum companies with their extensive formulating, marketing and servicing know-how.

► **Chemical All the Way**—While the dibasic esters, of which this second generation of aircraft oils consists, came of age commercially, the third generation was born—sired by chemical companies. Early this year, after a three-year search, the Air Force qualified two compounds, under what had been target specification Mil-L-9236A, for lubricants for the B-70, Mach 3 jet which is expected to be in the air in 1962 or 1963.

One developed by Celanese is derived from trimethylolpropane, the other developed by Heyden Newport is believed to have a neopentylglycol ester base. Other compounds which have been tried and thus far failed: a chlorophenyl silicone, a polyglycol plus additives, a methyl phenyl silicone, a high-molecular-weight sebacate plus additive.

Both of the final accepted formulations contained a high-temperature antioxidant whose usefulness was discovered by Wright Air Development Center. Identified as 5-ethyl-10-di-phenyl phenazasilane, or 5-10-10, the organo-metallic compound is produced by Metal & Thermit and Merck Sharpe & Dohme.

► **Hotter and Hotter**—These 9236 oils must retain desired viscosities at sustained 400 F. ambient temperatures and short intermittent exposure to internal engine temperatures of 600 and 700 F. under oxidizing conditions. Coking, volatility and foaming must be low under these conditions.

In comparison, the first synthetic lubricants—qualifying under Mil-L-7808—have to face sustained temperatures of 300 F. with intermittent exposure to 500 and 600 F.

Commercial versions of supersonic aircraft typified by the B-

70 are not expected until around 1967. Manufacturers of the new 9236 oils hope performance bonuses will open up the field in present jets. Celanese aims at selling the commercial market at the million-gal./yr. level by 1963.

Heyden Newport points out the new lubricants' potential usefulness in the jets' brand new bid for air-cargo trade. Unveiled last month, new turbofan jet engine designs for the Boeing 707 aircraft are aimed at better take-off performance under heavier loads and better economy at high speeds than straight jets. They'll carry 100,000 lb. of cargo at 600 mi./hr. at 3¢/ton-mi. compared to 6-7¢ for piston-powered air freighters.

The price tag of the 9236 oils, which is reported as high as \$75/gal., will probably have to come down to tempt commercial operators. A contributor to high cost is the \$200/lb. price of 5-10-10 additive, the silicon-containing analogue of phenothiazine. According to producer Merck, 5-10-10's price could come down, with a reasonable commercial volume of production, to the \$5-\$10/lb. level, not prohibitive considering the small quantities needed for lubricant formulation. But companies are also looking at less expensive analogues.

► **Hydraulic Fluids, Too**—The quest for high temperature hydraulic fluids is closely tied to the Air Force's search for high temperature lubricants. Until the B-58, which travels at speeds in the Mach 2 range, petroleum-based fluids served satisfactorily. Commercial jet aircraft, which operate slightly below Mach 1, are using a fire-resistant, phosphate ester hydraulic fluid produced by Monsanto.

For the B-58 category, the Air Force has set up a -65 to 400 F. temperature range for hydraulic fluids. Only one has qualified so far: Oronite's blend of disiloxane ester and dioctyl sebacate in which oxidation- and hydrolysis-inhibiting additives have been incorporated. Present price is about \$20-\$25/gal.

For the B-70 Mach 3 category, tentative temperature range is -65 to 550 F. One possibility is that the same fluid be used for the hydraulic and lubrication systems. Celanese has such

hopes for its trimethylolpropane-based ester, already tentatively approved for B-70 lubricant use.

General Electric, who is developing the B-70's J-93 engine, has similar hopes for its F-50, a methyl chlorophenyl silicone. One problem has been in finding suitable antioxidants; some combination with iron octoate may prove to be the answer. Another problem with silicones in general has been the need to improve lubricating ability on sliding surfaces.

► **Better Ester Bases**—Meanwhile, research to improve and extend the approved list of 7808 synthetic lubricating oils has not been standing still. Late in 1958, at least 14 oils qualified under the specification; now there are 32, some of which may be very similar products under different brand names. In addition to Esso's original sebacates, lube-oil ester bases now include pelargonates, adipates, azelates.

Most of the petroleum companies are in the field. Esso's lubricant had been the only one used in the new Boeing 707 commercial jets. In October, Texaco succeeded in invading the field, and others will probably follow fairly rapidly.

Supplying esters are a long list of companies including Emery, Monsanto, Celanese, E. F. Drew, Tennessee Eastman, Rohm & Haas, Dow, Du Pont, Carbide. Additives called for in 7808 oils include thickeners like the acryloids, antioxidants like phenothiazine, anti-wear agents such as tricresyl phosphate.

Because of the years of military experience with jet-product qualifications, commercial operators can profit from some of the military leads. And for their part, the military keep adding refinements.

Just this year WADC solved its biggest remaining headache with 7808 oils: storage instability. Air Force researchers have developed an anti-deterioration additive permitting maximum storage of three years whereas former limits ranged from six months to two years. The product, which makes up only about 0.1% of a lubricant formulation, is 2, 6-ditertiary butyl *a*-dimethylamino *p*-cresol, made by Ethyl. (Commercial lube con-

OFF AGAIN ON AGAIN SAVE AGAIN



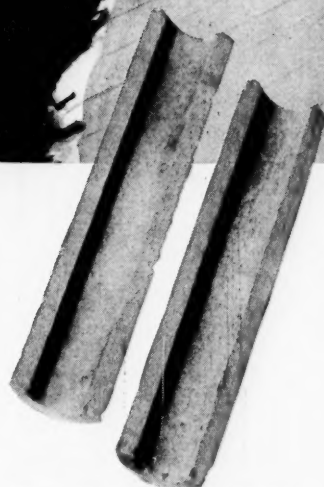
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Why is Unibestos worth more at competitive prices than other insulations? One California refinery required removal and replacement of Unibestos insulation from a 24-inch line **TWICE A MONTH FOR FIVE YEARS!** Naturally, these people now use Unibestos exclusively.

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UNIBESTOS AFTER 25 REUSES

Unretouched photograph of typical sections of Unibestos pipe insulation after 25 reuses. Rugged qualities of Unibestos make reuse on changed lines or test lines standard operating procedure under all types of conditions.

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UNION ASBESTOS AND RUBBER COMPANY • FIBROUS PRODUCTS DIVISION

DEPT. 253, Bloomington, Illinois

sumers do not have as serious a long-term-storage problem.)

► **Lubes for 1,000 F.**—For the military, the next step after the 400-F. 9236 oils will be 500-F. oils, possibly within a year, to service a refinement of supersonic aircraft which would take flight in about 1965. Ultimate goal is a radiation-resistant lubricant that will perform satisfactorily at 1,000 F.

Types of engines and aircraft—manned or unmanned—which these tubes would service are still far enough off to be highly conjectural. Possibilities include ram jet and nuclear-propelled craft, and the Dyna Soar, a glider-type craft which would be rocketed to such an altitude that it would coast around the earth on its momentum.

This far into the future synthetic lubricants look more and more like hydraulic fluids—partly because distance blurs distinctions, but also because moving parts become scarcer as engine designs advance and because fluid systems are more likely to be sealed off from oxygen.

► **Fluid Cold, Fluid Hot**—Up to and including the 9236 level, the Air Force has asked for and been able to get products with -65 F. engine-starting capability. Many in industry, however, consider it impractical to insist upon low temperature fluidity in future lubricants. To get the high temperature properties it will need, the Air Force will have to settle for lubricants with relatively high viscosities at low temperatures. Roughly 50 deg. can be added to the high temperature operating limit of a lubricant for every 10-deg. sacrifice in its low temperature requirement.

If a -65 F. temperature requirement is insisted upon, silicone fluids may be the best candidates for covering the entire temperature range (up to about 700 F.), despite their present steel-to-steel lubricity problems. And, according to a WADC spokesman, use of additives to improve lubricity may well make the silicones serious contenders at less extreme temperatures, too.

► **Mineral Oil Not Out**—A somewhat unusual result of diminishing emphasis on low temperature

fluidity is the re-entry of petroleum oils as future lubricant candidates. Due to the comparatively high bond energy of the hydrocarbon chain, mineral oils possess high thermal stability. Improved products would be highly refined, dewaxed, free of trace contaminants such as nitrogen and sulfur.

One approach being investigated at Pennsylvania State University under Air Force contract has yielded a prototype fluid for use from -40 to 550 F. ambient. The base fluid is derived by severe hydrogenation of paraffinic mineral oil followed by an associated low temperature (-65 to -120 F.) dewaxing process. Such prototype fluids have been pump tested and have been proved better than any other fluids tested under comparable conditions.

► **Polyphenyl Ethers**—Another approach to high temperature hydraulic fluids and lubricants is indicated by a study of the polyphenyl ethers. Monsanto and Shell Development have both performed research on these fluids under Air Force contract. As hydraulic fluids, certain polyphenyl ethers show potential at 40 to 800 F. or higher; Republic Aircraft is performing application studies on them. In addition to high temperature stability, one of the most attractive properties of polyphenyl ethers is resistance to nuclear radiation, and intensive investigation of this behavior is now underway.

Organometallics, nitrogen-containing heterocyclics, and inorganic polymeric fluids represent structures which are being investigated to determine feasibility of such compounds as building blocks for new fluids. Certain of these building blocks are thermally stable in the 800-1,000 F. range. However, modification of these structures to broaden this fluid range results in less thermally stable structures, and attempts are being made to overcome this problem.

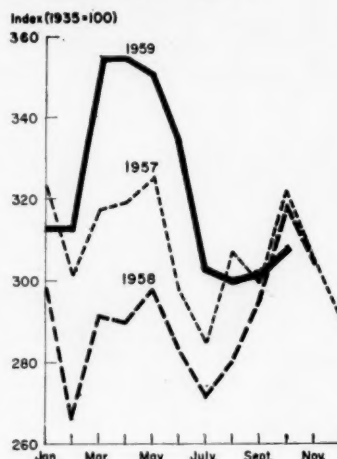
► **Pyrazine Potential**—The pyrazine ring has considerable potential. This is based on the fact that an aromatic or heterocyclic structure containing the nitrogen atom has provided the most efficient high temperature antioxidants and that the pyra-

zine ring alone shows thermal stability at temperatures on the order of 1,000 F.

Tertiary amines also appear to possess desirable characteristics. An almost unlimited number of possible compounds exists, and desirable viscometric properties can easily be obtained by proper substitution on the nitrogen atom. Pure alkyl tertiary amines have been studied and have shown excellent oxidation stability. However it appears more desirable to derive fluids where the "R" grouping is alkyl-aryl.

Both the pyrazine ring and tertiary amine structures could be utilized in the synthesis of organometallics to obtain high-temperature stability.

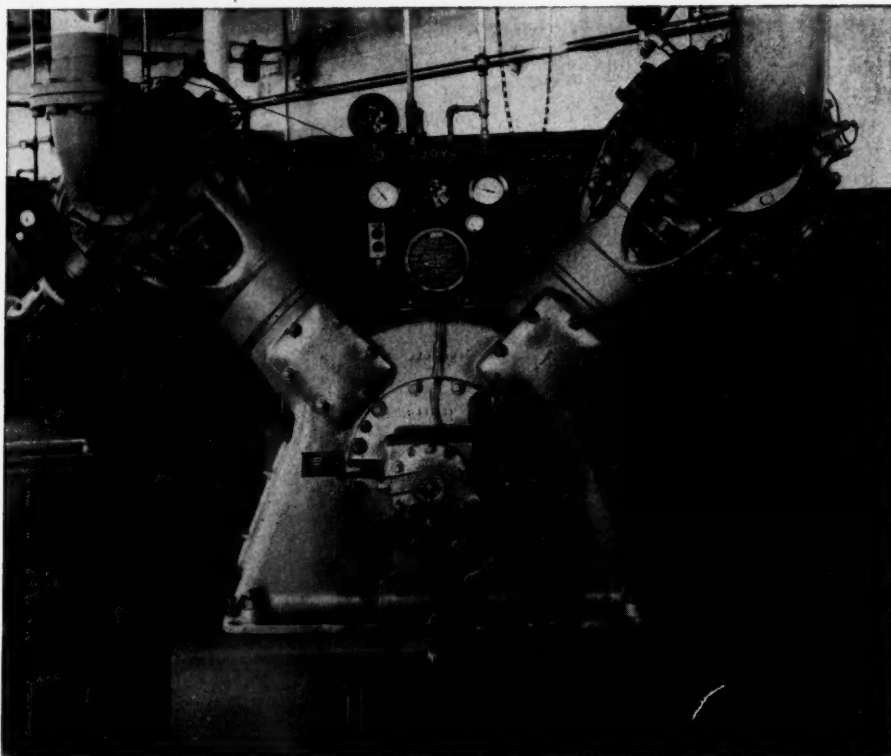
Chemical Consumption



Consumption by Industries

	Sept. (Final)	Oct. (Final)
Coal products	2.2	2.2
Explosives	10.3	10.6
Fertilizer	66.1	72.9
Glass	26.3	29.5
Iron & steel	2.8	3.1
Leather	4.4	4.3
Paint & varnish	37.7	34.4
Petroleum refining ..	35.6	30.9
Plastics	32.0	32.3
Pulp & Paper	40.2	43.7
Rayon	27.1	25.8
Rubber	8.1	8.1
Textiles	10.4	10.6
Total	303	308

MAINTENANCE-FREE JOY COMPRESSORS PROVIDE LOW COST PLANT AND PROCESS AIR



The cost of your plant and process air depends both upon the installed cost of the compressor and the cost of maintenance necessary to keep it operating. Joy compressors offer savings in both areas.

Installed cost of Joy compressors is lower because of the space-saving design. However, the big savings are realized in the low maintenance required for Joy compressors—particularly in the oil-free types. For example, the compressor above has the exclusive T-block design piston rings

that last twice as long by automatically compensating for wear. As for valves, which normally require inspection and maintenance, Joy designers have made them readily accessible and secured by only three well-positioned bolts.

Joy reciprocating compressors are available in a wide range of sizes for both oil-free and plant air service. For complete information on how Joy compressors can save you money on air, write for Bulletin 349-11.



AIR MOVING EQUIPMENT FOR ALL INDUSTRY

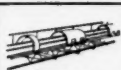
349-764



Dust Collectors



Compressors



Conveyors
and Idlers

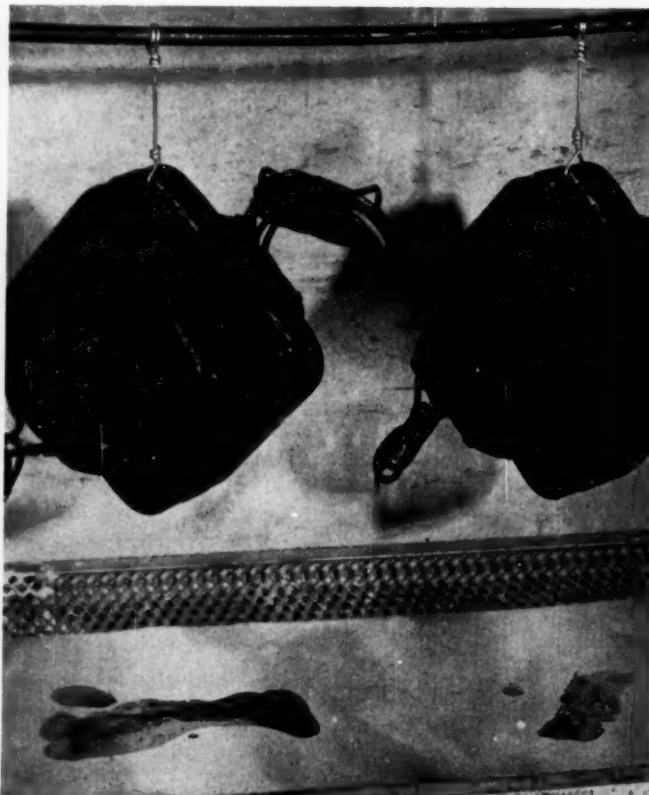


Fans and
Blowers

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company
(Canada) Limited, Galt, Ontario



Ease of Use Marks New Class H Varnish

After a full cure of 6 hr. in a 150-C. oven, transformer impregnated with new Dow Corning 980 Varnish (right) has only a fraction of the run-off of the organic varnish impregnated transformer. The new Class H silicone dipping and impregnating varnish is said to be as easy to process as most Class A and Class B varnishes.

Despite its low curing temperature, it meets AIEE requirements for use in 220-C. systems, has greater heat stability than any other varnish known. It resists moisture and is unaffected

by many corrosive atmospheres.

Reportedly, the new varnish will make it possible for original equipment manufacturers and service shops to produce Class H units on production equipment designed for Class A and Class B equipment. The high temperature curing ovens previously required to process Class H varnishes are not needed for this new varnish. Supplied as 59% solids in diacetone alcohol, it has a higher flash point than xylene or toluene impregnating solutions.—Dow Corning Corp., Midland, Mich. 68A

Herbicide

First chemicals capable of safely combating wild oats.

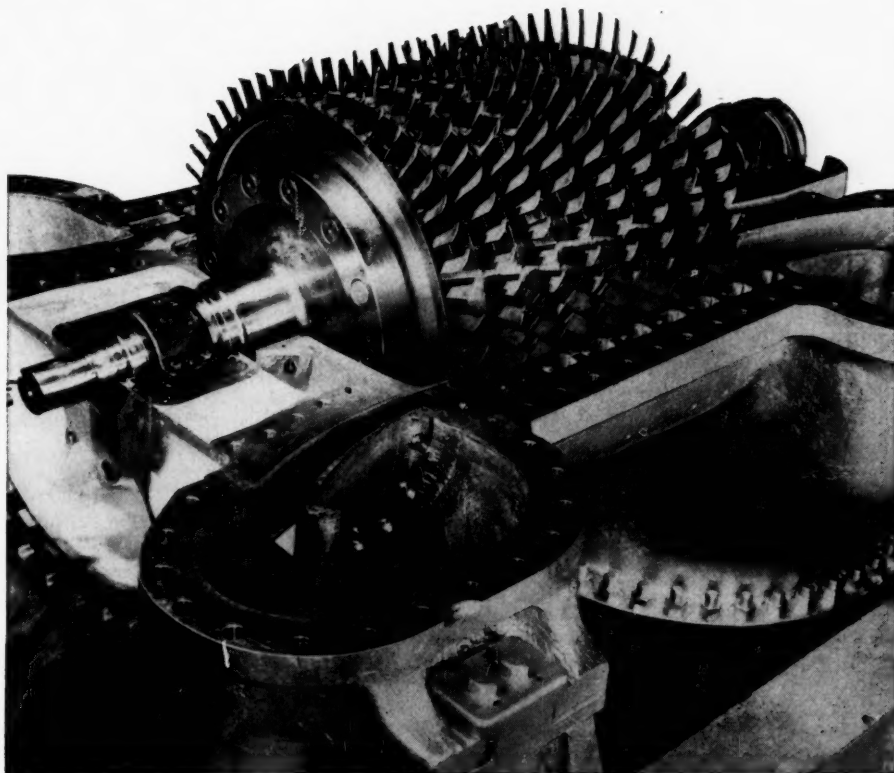
A compound which gives safe and practical control of wild oats, now infesting more than 60 million acres of cropland in the Great Central Plains of western Canada and bordering United States, has been developed by Monsanto. Chemically identified as 2,3-dichlorallyl diisopropylthiocarbamate, it is called Avadex. Exhaustive radio-tracer studies and chemical analysis of crops grown on treated soils show that Avadex leaves no residues in crops, even when applied at more than double the rate recommended for efficient wild oat control.

First public confirmation of the product recently came from Canada's National Weed Committee which officially recommended it for registration and sale in Canada this year as a wild oat control in both small grains and row crops.

The chemical is recommended for pre-planting use at rates of 1½ to 2 lb./acre to control wild oats in flax, barley, rape, sunflower and sugar beets. It remains active in the soil for six to eight weeks or more during which time it selectively kills wild oats as they germinate.

Close biological relationship between wild oats and economically important small grains challenged scientists for many years before finding a chemical which kills the weed without also killing the crops it infests. Weeds are estimated to cost Canadian farmers more than \$250 million each year. Wild oats are reported to account for half of this total cost. About 4 million bushels end up being shipped each year to terminal elevators where they must be removed

HIGHER STAGE PERFORMANCE OF JOY DYNAMIC COMPRESSORS MEANS LOW COST AIR



The higher stage performance of Joy Centrifugal and Axial Compressors can save you money by reducing the cost of your plant and process air. Because of higher efficiency, Joy compressors can provide the air you need with fewer stages. This means fewer parts, fewer inter-stage seals, shorter and more rigid rotors, lower bearing loads, and many other design features which reduce both the installed cost and the main-

tenance cost of the machines.

Joy dynamic compressors can be supplied in sizes from 15 to 15,000 hp, and can be designed for any class of service from furnishing plant air to compressing hot process gases. Whatever the air or gas compressing problem, you can be certain that a Joy dynamic compressor will be the most efficient solution. For complete information, write for Bulletin 348-11.



AIR MOVING EQUIPMENT FOR ALL INDUSTRY



Dust Collectors



Compressors



Conveyors
and Idlers



Fans and
Blowers

348-783

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

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(Canada) Limited, Galt, Ontario

from grains as dockage at the growers' expense. — **Monsanto Chemical Co., St. Louis, Mo. 68B**



Polyethylene

Gloss of polishes made with new low molecular weight resins is compared, above.

Three entirely new resins offer low molecular weight polyethylene users a wide range of molecular weights (1,500-7,000), densities (0.902 to 0.956) and viscosities.

The first, called Epolene LVE, is an emulsifiable, low viscosity (170 cp. at 160 C.) type of polyethylene, with a molecular weight of approximately 1,500. It has good anti-slip properties and rebufferability when used in floor polish formulations. It's also useful as a softening agent in conjunction with resins used to treat wash-and-wear fabrics, as a sizing agent for textiles, in emulsion paper coatings, and as a paraffin modifier to improve coating adhesion and heat stability.

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p 165)

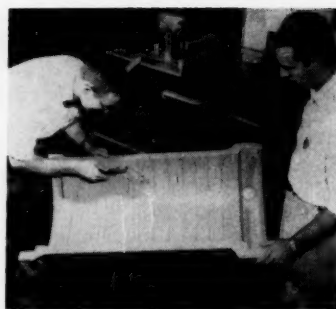
A second, called Epolene HDE, is described as the highest density (0.956), low molecular weight (1,500) emulsifiable polyethylene on the market. It may be handled as a wax due to its low melting point and viscosity (160 cp. at 160 C.). HDE deposits an extremely hard film when used in self-polishing floor polish formulations, due not only to its extreme hardness but also because of its excellent compatibility with oleic acid, a floor polish ingredient.

The hardest type, Epolene HD, possesses low viscosity (150 cp. at 160 C.), is non-emulsifiable. HD type has a bright future in printing ink applications because of its exceptional hardness; it can be ground with ink vehicles into a fine dispersion which is stable, has little tendency to separate from the vehicle.

Properties

Emulsifiable,.....	Yes	Yes	No
Brookfield viscosity, cp.			
160 C.....	170	160	150
140 C.....	250	265	220
120 C.....	400	455	340
Penetration hardness, tenths of mm, 100 gm./5 sec. @ 77 F.....	5	1	0.5

Company's production facilities have been expanded at Longview, Tex., to permit early availability of the new compounds on an industrial scale, and to meet increasing demands for the four Epolene compounds already commercially available. —**Eastman Chemical Products, Inc., New York. 70A**



Reinforced Polyester

Successfully used to manufacture light, low cost jet engine housings.

A standard production-line jet engine with a reinforced plastic compressor housing instead of the usual metal one has operated successfully for 150 hr.—the airborne equivalent of approximately 75,000 mi.

The plastic resembles the type successfully employed in the nose cones of missiles. However, this marks the first time that a plastic component of such size and complexity has been incorporated into an experimental jet engine and proved capable of withstanding all the rigors of full-scale engine operation.

Compressor housings for jet engines ordinarily are made from castings of aluminum or magnesium alloys, or they are sheet steel fabrications. With the new development, designers can anticipate compressor housings and similar components to

Newsorthy Chemicals

Page Number is also
Reader Service Code Number

Silicone varnish boasts ease of use.....	68A
Herbicide safely combats wild oats.....	68B
Polyethylene offered in range of low molecular weights.....	70A
Reinforced polyester for low cost jet engine housing.....	70B
Alumina excels conventional potting compounds.....	72A
More carbon-14 compounds become commercial.....	72B
Vinyl foam made continuously is more uniform.....	72C
Iron oxide powder comes in 200-1,000 angstrom sizes.....	72D

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For chemical cleaning of stainless steel equipment such as boilers, heat exchangers, atomic reactors and chemical processing equipment, citric acid is the product of choice. Now, by using citric acid (which is chloride free), you can be sure of *safe, efficient cleaning with reduced after-rinsing*. Citric acid has a history of proven success.

Here are the unique advantages of Pfizer Citric Acid that you can discuss with your chemical cleaning service company:

- 1.** Citric acid is highly efficient in removing imbedded metal and oxide film from stainless steel.
- 2.** Citric acid's excellent sequestering ability prevents reprecipitation of dissolved scale.
- 3.** Citric acid cleaning completely eliminates the possibility of chloride stress corrosion.
- 4.** Citric acid can be effectively inhibited without losing its cleaning or sequestering ability.
- 5.** Citric acid is sold as a dry, 100% acid—meaning savings in storage and handling.
- 6.** Citric acid is water soluble, easy to handle, and non-toxic.

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Alumina Excels Conventional Potting Compounds

A new approach to the protection of transformers and other electrical components which must be sealed against humid environments has been revealed by Bell Telephone Laboratories. Powdered alumina is used to fill the cans surrounding the component (see photo above), instead of conventional asphalt or plastic potting compounds.

This approach allows a damaged component to be depotted simply by cutting the can open and pouring out the dry powder. Conventionally potted compo-

nents are difficult to reclaim.

Melting point of the powdered material is well above the possible operating temperatures of any electrical or electronic component. Therefore it does not expand or contract significantly on heating or cooling, possibly damaging the component.

It should be competitive in price with conventional potting compounds and their equal in electrical properties, and from heat transfer aspects. — Bell Telephone Laboratories, New York. 72A

be lighter, lower cost, corrosion-resistant and easier to manufacture. The plastic is more corrosion-resistant than alumi-

num or magnesium, especially to the damaging attack of salt water; and above a temperature of 450 F., the plastic housing is

considerably stronger than one made of either metal.

The plastic material is described as a polyester resin reinforced with glass cloth. The housing was produced by using special high-pressure molding techniques.

The laminated plastic produced by this technique is said to be unusually strong, stable and workable. Drilling and machining time to prepare the housing for assembly was two-thirds less than that required for a standard production housing of aluminum or magnesium. Westinghouse Electric Corp., Pittsburgh, Pa. 70B

BRIEFS

Radioactive carbon-14 . . compounds, Adenosine-8-C¹⁴ and α -amino isobutyric-1-C¹⁴ acid have been added the list of over 200 carbon-labelled compounds available from this company. Adenosine-8-C¹⁴ is a radioactive purine useful in the study of carbohydrate metabolism since it is a constituent of plant and animal nuclei. α -amino isobutyric-1-C¹⁴ acid has been useful in the study of proteins.—Nuclear-Chicago Corp., Des Plaines, Ill. 72B

Laminated plastics, Grades ARF-HT and G3-HT have been developed for higher temperature use. The former consists of an asbestos mat reinforcement with a modified phenolic resin binder for resistance to 500 F. The latter has a glass fabric reinforcement and a modified phenolic resin binder for a recommended temperature resistance of 500 F.—Synthane Corp., Oaks, Pa. 72C

Iron oxide powder in the 200-1,000 angstrom size range has been produced in sample quantities. These and other finely particulated materials of less than 1,000 angstrom size are the product of a broad development program using the high intensity electric arc.—Vitro Laboratories, West Orange, N. J. 72D

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GIVES Certified

100/150 MVA FAULT PROTECTION

**NO SINGLE PHASING
FROM BLOWN FUSES!**

**NO COSTLY REPLACEMENT
FUSES TO STOCK!**

✓ Gang-operated Disconnect
Switches Grounded for Safety
in Open Position. Mechanically
Interlocked with Contactor...
Never Open Under Load

✓ No Fuses. Bus Bars Throughout

✓ 3-way Door Interlock. On, Off
and Open—with Positive Inter-
locking between Door, Discon-
nect and Contactor for Maximum
Personnel Protection

✓ Heavy-duty DC Operating
Magnet. No Chatter—No Hum

FRONT ACCESSIBLE WITHOUT ROLL-OUT!

Phase barrier and arc-
chutes slide out. All starter
parts exposed and accessi-
ble for easy inspection
and maintenance



Get the complete story on certified fuseless fault protection
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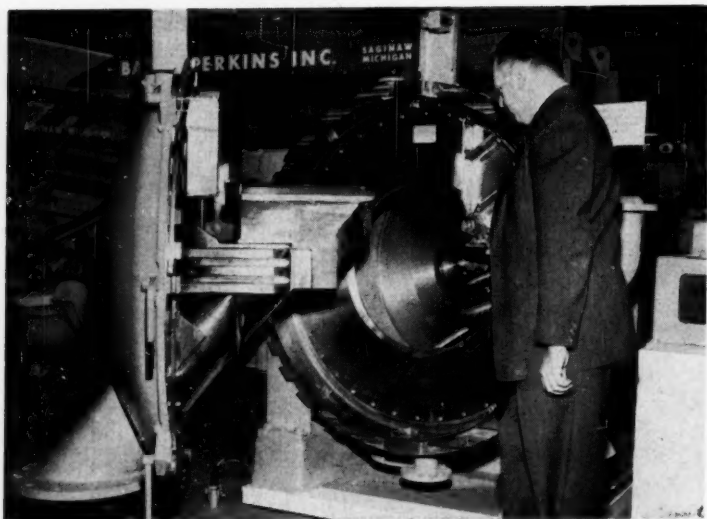
SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

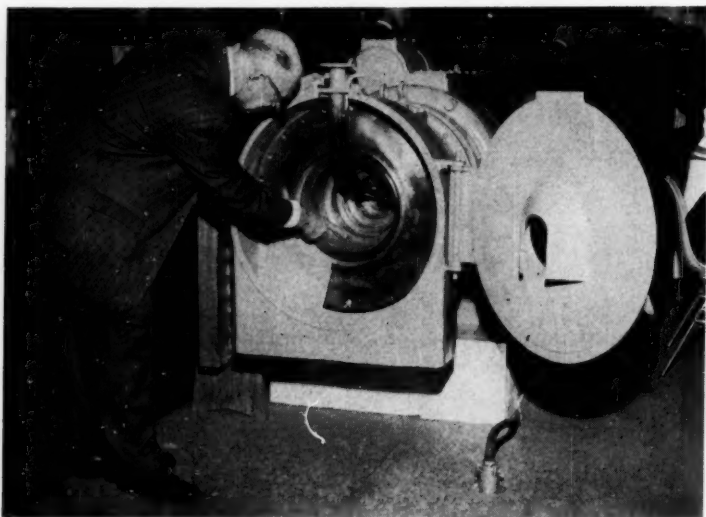
wherever electricity is distributed and controlled

2635

New Models Round Out Centrifugal Line



PRESSURE CENTRIFUGAL is largest member of new additions to line.



MULTISTAGE SEPARATOR comes to U.S. market for the first time.

Increasing its stride in the race for solid-liquid separation jobs, equipment manufacturer adds four new models to centrifugal line.

More than doubling the previous size of its long-standing line, Baker-Perkins took the wraps off four brand-new centrifugals at last month's Chem Show.

One machine is ideal for pilot-plant operations, another for delicate handling of friable crystals. A third unit meets requirements for high-capacity service at elevated pressure, and the fourth for processing materials that are difficult to centrifuge in a single separation stage.

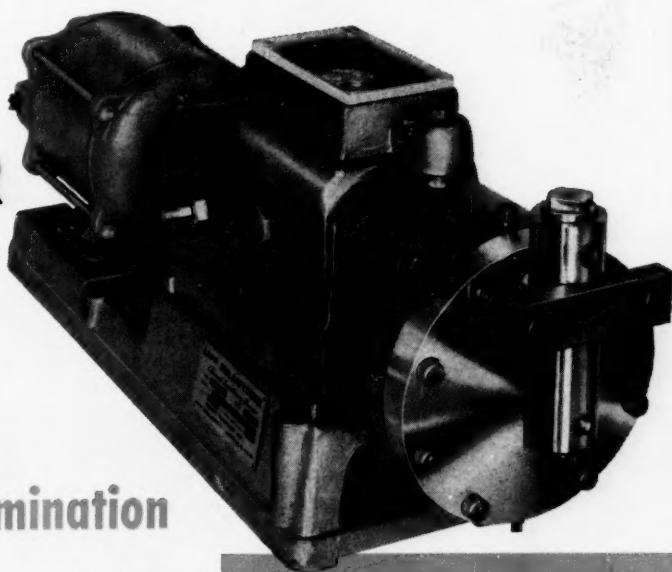
► **Pressure Centrifugal**—Engineered for normal operation at 1,000 g.'s and internal pressures to 150 psi., B-P's new 40-in., horizontal, automatic batch centrifugal (HS 40W) features a mechanical self-balancing shaft seal. Positioned where the main shaft enters the housing, this component is the only major moving seal.

Arrangements for locking and sealing the door are also interesting. Consisting of a floating ring plus two O-rings, the door seal is self-aligning and self-seating. Manipulation of four cam-actuated bars can safely lock the door in seconds. The door hinge is conventional, not articulated.

Design of knife box and chute promotes complete discharge of all solids. A special knife-box switch enables automatic peeling at progressively greater

This metering pump has NO STUFFING BOX

Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

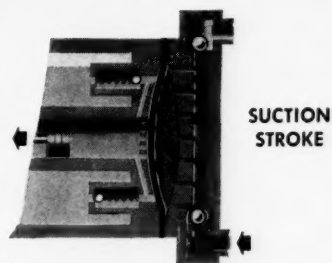


Prevents Costly Leakage and Contamination

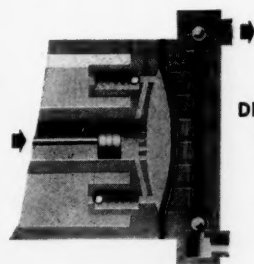
Lapp Pulsafeeder is a piston-diaphragm pump having a hydraulically balanced diaphragm and a closed hydraulic system. Its reciprocating piston action provides accuracy of positive displacement while the diaphragm isolates liquid being pumped from the pump's working parts. Eliminates need for stuffing box or running seal . . . prevents product leakage and contamination. Maintenance costs, too, are reduced to next to nothing. There are practically no repairs or replacement parts.

All Pulsafeeder pump parts contacting liquid are of special corrosion-resistant materials. Pumping speed is constant; variable flow results from variation in piston-stroke length, controlled manually by hand-wheel, or, in auto-pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable. Pulsafeeder capacities range from 585 ML per hour up to 24 gpm maximum flow and pressures from minus atmospheric to 6800 psig.

WRITE FOR BULLETIN 59 containing typical applications, flow charts, description and specifications of models of various capacities and constructions and special leakage chart. Lapp Insulator Co., Inc., Process Equipment Division, 3614 Poplar St., Le Roy, New York.



SUCTION
STROKE

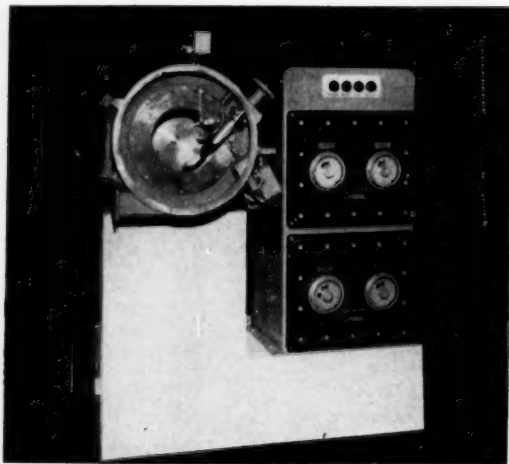


DISCHARGE
STROKE

Lapp



VERTICAL CENTRIFUGAL (above) slows down for charging operation. PILOT CENTRIFUGAL (below) has both automatic and manual controls.



depths; heel glazing cannot occur.

Basket capacity of the HS 40W is 8 cu. ft.; as a guide, throughput is quoted as 26 tons/hr. of ammonium sulfate. Drive motor is 125 hp.

► **Multistage Separator**—Developed by Escher-Wyss Co. of Zurich, Switzerland, B-P's new C-14 made its debut as the fore-runner of a complete series of multistage, push-type, continuous centrifugal separators to be offered on the American market.

It is designed primarily to process materials that are difficult to handle with single-stage

machines. Thus, B-P predicts that the C-1/4 will prove excellent for fine (50-100 microns), slow-draining crystals. It should fit the bill for operations where the mother liquor's viscosity runs unusually high, or for cakes that tend to hump.

Rather than a single, long basket, C-1/4 has four short baskets, each of successively larger diameter, telescoped over one another. Alternate baskets attach to a hub and pushing mechanism in such a manner that the end of each basket serves as pusher for crystals on the following stage. As solids

move from one stage to the next toward the discharge point, the cakes loosen. This action facilitates draining.

Depending on pulley connection to the 5-hp. drive motor, basket speed varies from 1,200 to 2,000 rpm. Push frequencies are 25, 33 or 40 strokes/min. Rated capacity, in terms of 16- to 20-mesh ammonium sulfate, is 3,300 lb./hr.

► **Vertical Centrifugal**—To prevent degradation of friable crystals during charging, B-P's new vertical VS-20 is slurry-fed at reduced rotational speeds. In operation, the automatic batch machine automatically accelerates for drying and washing operations, then decelerates for discharge via vertical hydraulic pusher. Charging time runs 1 or 2 sec.

Assuring uniform batch size, a triggered float that mechanically couples to the charging valve closely controls slurry load. Because cycling timers allow for long wash periods and long spin times, viscous slurries are easily processed. Design permits easy separation of wash liquor from mother liquor.

Maximum operating speed of the 20-in.-dia., 12-in.-deep basket is 1,875 rpm. B-P rates capacity as equivalent to 6,000 lb./hr. ammonium sulfate.

► **Pilot Centrifugal**—Research, pilot-plant and limited production operations rank as chief applications for B-P's new HS 10W Universal centrifuge. Priced at \$5,000 to \$6,000, this 10-in. model comes equipped with the same kind of automatic timing mechanisms utilized on standard B-P production machines. Manual control is also possible.

In the interest of economy, some departures from standard machine construction are evident; for example, basket and shaft are welded together. A single double-bearing pillow block acts as shaft mount.

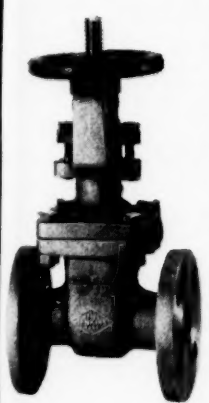
Operating at a maximum speed of 4,500 rpm. and equivalent centrifugal force of 2,500 g.'s, the machine has a capacity of 300 lb./hr.—Baker Perkins, Inc., Saginaw, Mich. 74A

Equipment Developments continues on page 78.



For 99 out of 100 . . . Selection of Stainless Steel Valves can be as simple as selection of Bronze and Iron valves

HOW to keep it simple? Don't let the wide selection of stainless steel alloys "throw you"!



Most of the alloy specs were developed to meet certain highly specialized and rather uncommon needs. Only 1 out of 100 valve users can make practical use of many of the alloys. *Actually, just two or three of the different avail-*

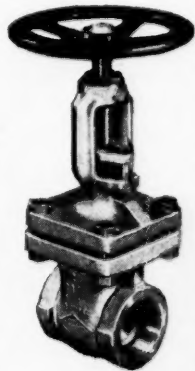
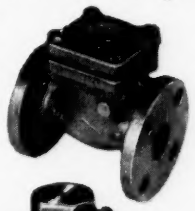
able alloys will give a big majority of valve users all they want and need.

You can judge DESIGN differences between the various "makes" exactly as you do it with Bronze and Iron valves. Look them over and compare. Basically, of course, a Stainless Steel valve is designed and constructed very much like other valves.



What is left to worry about in addition to Material and Design? The

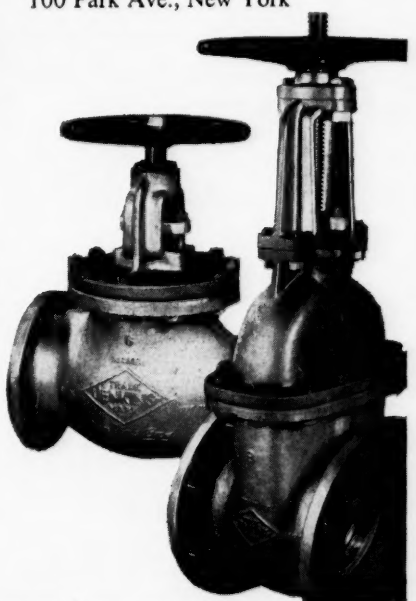
same factors you consider in buying ANY valves for long, dependable performance: Are the valves made merely good enough, or to a standard that demands an extra-measure of quality? How good are the castings? How precise and perfect is the machining? How rigid is the inspection and testing during manufacture? These are the factors which specs can't cover. Some of them you can't see when you look at the valve. But you KNOW how to make sure they measure-up to peak standards. You know that the name



JENKINS VALVES and the famous Jenkins DIAMOND trademark have been the highest assurance of quality for nearly a century.



Specify "Jenkins" as well as the metal alloy to assure fullest satisfaction. Your Jenkins Distributor has patterns and alloys to satisfy most industrial needs. Of course, they meet valve industry specifications and the high standards established by leading users of stainless steel valves. Jenkins Bros., 100 Park Ave., New York



Jenkins Bros.
100 Park Ave., New York 17.

Send Jenkins Stainless Steel Valve Catalog to —

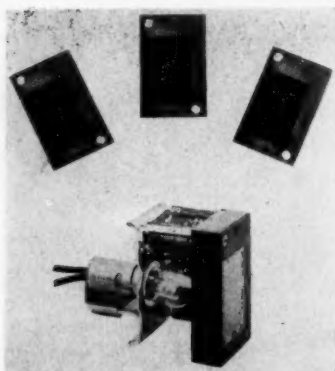
Name & Title.....

Company.....

Address.....

JENKINS VALVES





Readout

Electromechanical device for economical display.

A direct binary-to-decimal decoding device, the CPR 16, accepts voltage signals of a computer or similar device and converts them into decimal numbers or other descriptive characters. It can display 16 individual, illuminated, intelligence characters per decade.

Readout characters are 1.2 in. high for maximum legibility. Operation time is less than 0.1 sec. A single standard lamp, easily changed, illuminates the readout plate. All moving parts are enclosed in a dust- and moisture-free, two-piece structure.—Genesys Corp., Los Angeles, Calif. 78A

Manway Assembly

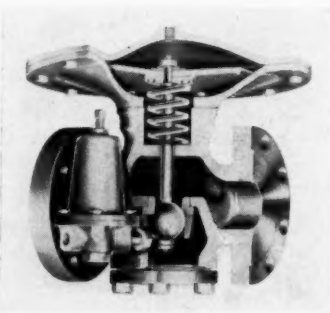
Low in first cost. Easy to install and open.

Comprising only three metal pieces as opposed to eight separate components of typical two-bolt covers, the new Lenape Wedge Manway cuts time and

cost of installing and opening pressure vessels. In addition, the assembly assures a higher degree of stability, and prevents tilt or twist that may occur with yokes and bolts.

Each unit consists of a ring, cover and key wedge. To install, the cover and gasket are positioned in the manway; the wedge is inserted between protruding handle and outside ringed wall, and is tapped until the seal is attained. To open, procedure reverses.

Available in 11x15- or 12x16-in. sizes, the manways come with a choice of standard rings, from ½x3 to 1x4 in.—Lenape Hydraulic Pressing & Forging Co., West Chester, Pa. 78B



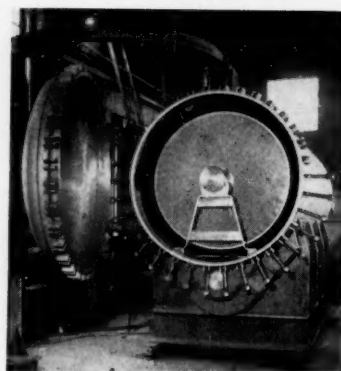
Reducing Valve

Item for steam service has external pilot.

Called No. KP-4, a new, pilot-operated valve meets all requirements for steam pressure-reduction applications. Although highly sensitive, simple operation assures trouble-free service. A turn of a screw on the pilot valve quickly makes pressure adjustments. Unit closes tightly for dead-end service.

To permit use with higher pressures and temperatures, the large main-valve diaphragm is made of stainless steel. The combination of steel-ball inner valve and Monel seat ring resists the wire-drawing effects of steam indefinitely.

Offered with bronze, semi-steel or cast-steel body, the valve comes in sizes from ½ to 4 in. Screwed or flanged ends.—Klipfel Valves, Inc., Hamilton, Ohio. 78C



Pressure Filter

Mammoth unit has high capacity, working pressure.

Buffalo Filters, Inc. recently completed fabrication of a record-size, rotating-leaf, horizontal pressure filter. First of a number of such units destined for synthetic fiber production, the Model RH-1200-5 has a working pressure of 200 psig., and can handle product viscosities of over 100,000 cp.

Having 31 leaves, the unit pictured above has a total filtration surface area of 1,200 sq. ft. Its volume for inorganic salts removed during filtration is a maximum of 150 cu. ft. The reinforced bottom trough shown in the photo houses a huge scroll, which is used to empty tank of polymer at the end of a production period. After washing, sluicing discharges the cake through the scroll, which then pushes the cake out of a central nozzle in slurry form. Leaf construction is 316 stainless.—Buffalo Filters, Inc., Buffalo, N. Y. 78D

Grinding Mill

Adapts to continuous or batch submicron operation.

A new process for precision fine grinding of a wide range of materials will soon be placed on the market. Intro-

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

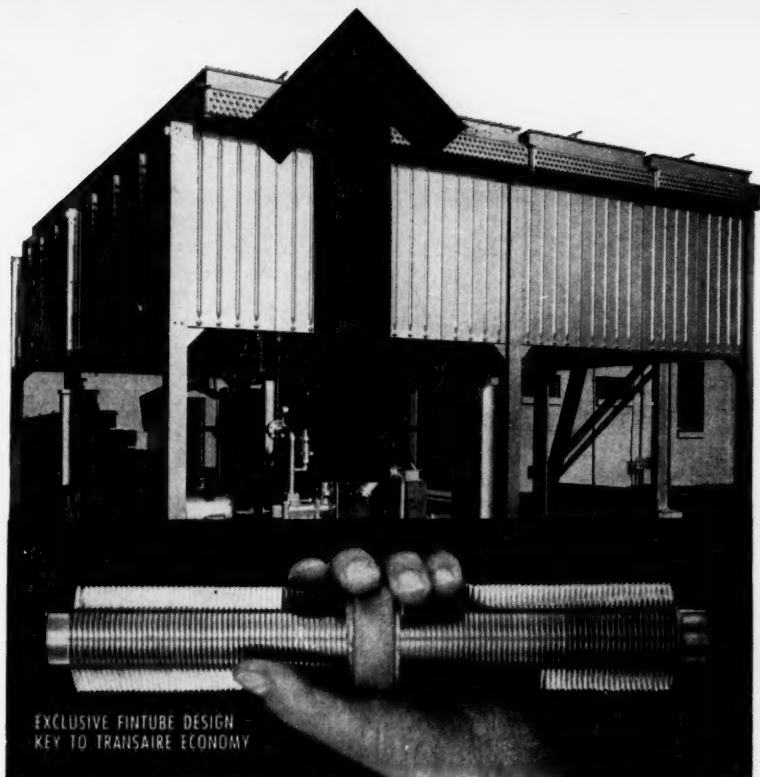
postcard (p. 165)

EQUIPMENT NEWS

Continues on . . . Page 146

WASTE HEAT LEAVES

...AT LOW
OPERATING
COST



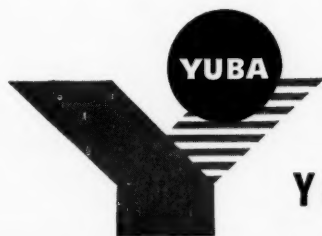
**Transaire Air-Cooled
Heat Exchangers
use free air
for most economical
heat dissipation**

When waste heat is to be dissipated, Transaire Air-Cooled Heat Exchangers do the job efficiently and economically. Simple in design, Transaire units are now being used in many varied processing operations. Even in areas where water is unlimited, the cost of providing cooling towers, pumps, water treating, etc., makes the use of Transaire exchangers attractive.

Transaire exchangers are mechanically and structurally designed to give low maintenance and operating cost for extended periods of operation. High heat transfer efficiency is obtained by use of the Aimco fin tube, an exclusive Yuba design with tapered spiral fins mechanically bonded so that the entire base tube is covered and protected against galvanic action. Fins are usually aluminum, although other materials are available for special requirements. Base tubing can be provided in practically any material, size or gauge desired. Fin spacing and height can be varied.

Next time specify economical Transaire, or if your present units are structurally sound, investigate modernizing through replacement with the new high efficiency Aimco fintubing.

Yuba also manufactures a complete line of shell and tube heat exchangers, and will recommend either type, whichever is required or best suited for the job.



specialists in heat transfer equipment

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New advantages such as these make it imperative to check your insulation specifications before rewriting them for a new project. Baldwin-Ehret-Hill offers you the complete line—a selection of over thirty different specialized insulation products for service from sub-zero to 1900 F. Each is designed to give you greater efficiency, easier application and lower installed cost. To bring your specifications up to date, write for our new 1960 catalog or see it in your Sweet's file.



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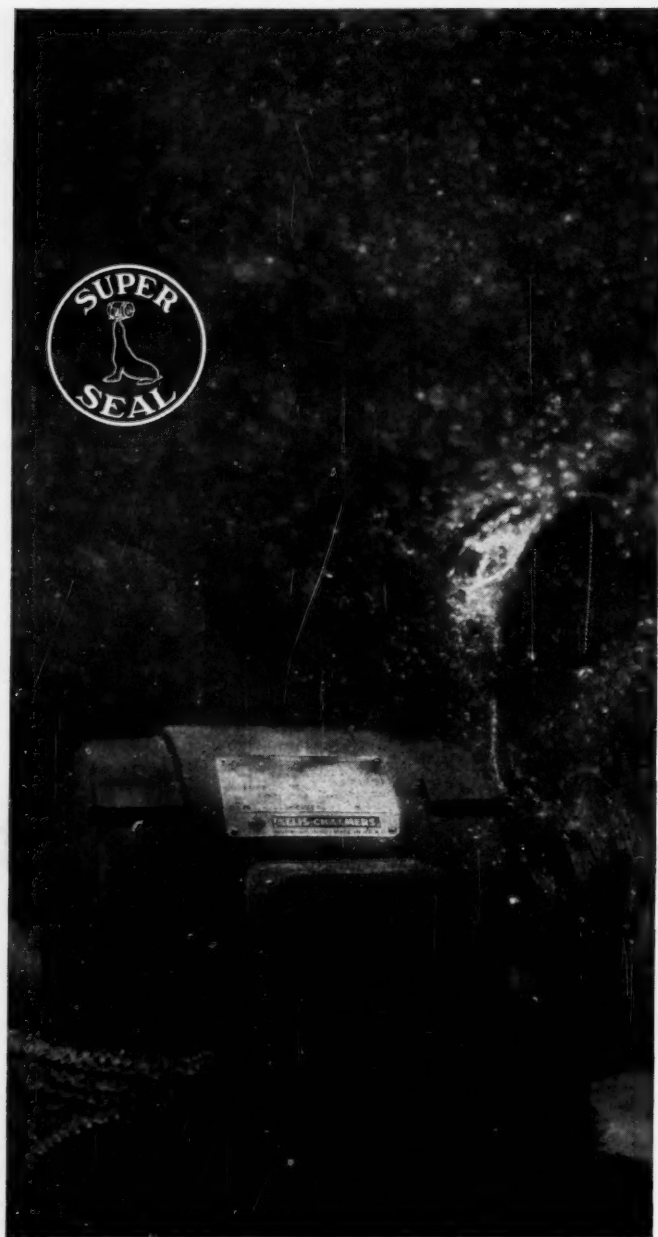
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PICKLED in a 4% brine solution!



CHOKED

in a tornado of abrasive dust!



FROZEN

for weeks at 75° C below zero!



BURIED ALIVE

in thick, sluggish mud!

nothing . . . but nothing stops Super-Seal open-type motors

Thanks to exclusive Poxeal and Silco-Flex insulations, Super-Seal motors have shown endurances that even enclosed motors couldn't match. Results and reasons available from your A-C representative or distributor. Or write General Products Division, Milwaukee 1, Wisconsin

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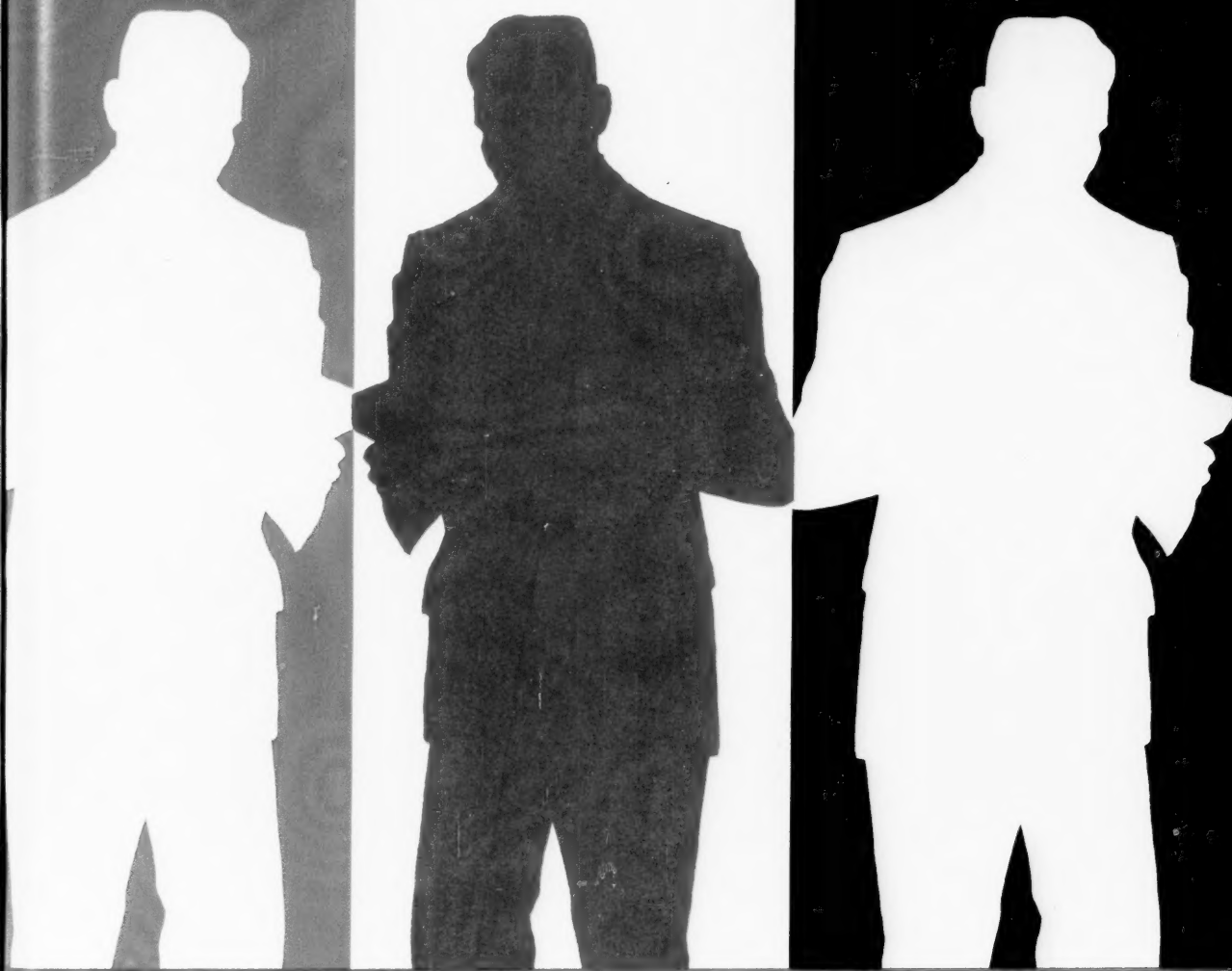


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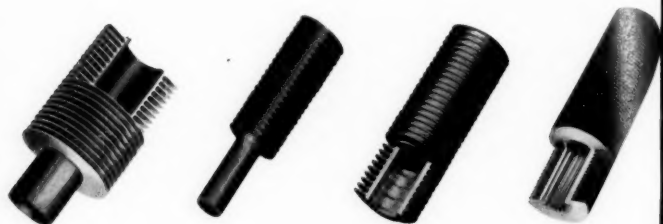
**LY WOLVERINE TUBE CAN SERVE ALL THREE THOROUGHLY
with this finned tube experience ➡ ➡ ➡**

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PRODUCTS



Wolverine Trufin®—the integrally finned condenser tube is available in a wide choice of metals, alloys and sizes in Types H/A, H/R, L, L/C, S/T. These various tubing types differ in fin heights and fin spacings. Duplex tubes with inner and outer tubes of different metals are available in types S/T and L/C. They are also available with four distinct types of end treatments. Wolverine also manufactures prime surface condenser tube in a wide range of sizes and alloys.



FIELD ENGINEERING SERVICE



For the benefit of its customers Wolverine's Field Engineering Service is staffed with tubing specialists who have specialized training in tubing, alloys and metallurgy, equipment design, heat transfer, etc. When you require heat transfer consultation, Wolverine has available a number of heat transfer specialists home based in the country's major processing areas. Their services are yours—without obligation.

FACILITIES



In addition to two tube manufacturing plants Wolverine also maintains a network of sales offices across the United States. Wolverine's Detroit, Michigan plant recently underwent a multimillion dollar modernization program that makes it one of the most modern tube mills in the United States. Its Decatur, Alabama plant, more than 1/4-mile in length, is equally modern — is equipped with the finest machinery available.

We'd very much like your next tubing order. We're equally very sure you'll like our tubing and services. A telephone call to the nearest Wolverine Sales Office (we're in the Yellow pages) will start things rolling. May we hear from you soon?

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News from National Carbon Company

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Sales Offices: Birmingham, Chicago, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. IN CANADA: Union Carbide Canada Limited, Toronto

Manager, Process Equipment Sales

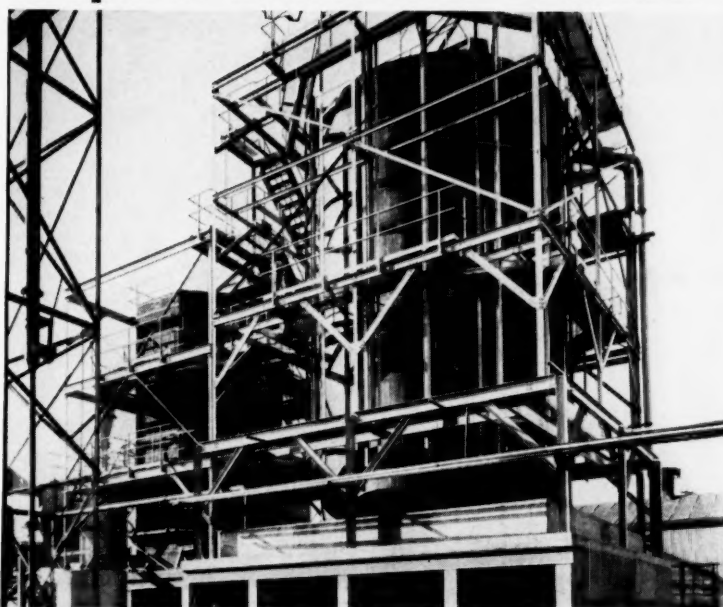


J. F. Revilock

Mr. Revilock was graduated from Case Institute of Technology with a B.S. in Chemical Engineering. For two years he worked at a mid-west research center, designing and installing chemical process equipment for pilot plant production of special aircraft fuels and lubricants.

Mr. Revilock joined National Carbon Company in 1944. For three years he worked in the Sales Department Development Laboratory designing and testing new "Karbate" impervious graphite products and improving existing equipment. For the past eleven years, he has been actively engaged in the design, construction, installation and process application of carbon, graphite and "Karbate" impervious graphite equipment. In 1954, he was appointed Manager of Process Equipment Sales, Chemical Products Marketing.

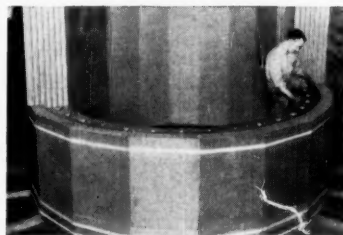
NATIONAL CARBON Makes the World's Largest Diameter Graphite Combustion Chamber



World's largest diameter graphite combustion chamber and a carbon hydrator tower will produce phosphoric acid from elemental phosphorus for The American Agricultural Chemical Company at their Carteret, New Jersey plant.

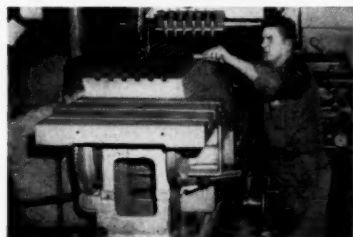
NATIONAL CARBON Has Facilities for Precise Machining of Large Structures

Photos show close tolerance machining of a wall block and factory pre-assembly of a block type graphite vessel for high temperature chlorination. Machining was done on new moving-bed horizontal milling equipment to tolerances of $\pm .010"$. The entire unit was pre-assembled in the plant with $.010"$ thick shims to simulate cement joints to be made in the final installation. Men with years of experience in machining carbon and graphite working with modern equipment make this



close tolerance work possible.

Working closely with NATIONAL CARBON's production staff are sales and technical service engineers with the industry's most extensive know-how in the design of carbon and graphite equipment for high temperature service. This combination of process knowledge and production experience makes National Carbon Company the leading supplier of graphite and carbon products used in the chemical process industries.



The graphite combustion chamber shown above — the largest in diameter ever installed—is being built with precisely machined graphite parts from National Carbon Company. It is 37'-3" high with an inside diameter of 20'-4". Phosphorus burned with air within the chamber is subsequently hydrated in the carbon tower shown at the left to produce phosphoric acid. This carbon hydrator is also the largest NATIONAL CARBON has ever built.

NATIONAL CARBON's graphite and carbon materials are well suited to this application because they provide corrosion-resistance and structural stability at elevated temperatures combined with ready machineability and moderate costs.



"National", "Karbate", "N" and Shield Device and "Union Carbide" are registered trade-marks of Union Carbide Corporation.



DEVELOPMENTS ...

PROCESS FLOWSHEET

R. A. LABINE



A few months ago, the nation learned of this country's first big facility making liquid hydrogen for missile fuels. Now, you have the first chance to look inside that plant and see . . .

How the Air Force Liquefies Hydrogen

In Palm Beach County, Fla., a freshly laid road cuts through the flat, marshy Everglades. At the end of the road looms Air Force Plant No. 74, heretofore masked under the whimsical title of "Papa Bear."

"Papa Bear," in U. S. Air Force argot, designates its latest high-purity liquid hydrogen plant—and the first unit to make this product on a tonnage basis (estimated at about 10 million lb./yr.). Plant was designed, built and is now operated by Air Products, Inc.

► **First Came the Problems**—Before economical production of tonnage liquid hydrogen could be achieved, Air Products had to wrestle with some tough problems never before tackled on a large scale.

The chief problem was essentially economic. Until the Florida plant went on stream, the only

way to get the necessary refrigeration for hydrogen liquefaction was the relatively inefficient Joule-Thomson expansion. By going back to the basic thermodynamics of hydrogen, Air Products was able to design ultra-high-speed hydrogen turbo-expanders to provide low-temperature refrigeration more efficiently (*Chem. Eng.*, Aug. 24, 1959, p. 70). "Without these expanders," says one Air Products engineer, "this plant could only put out about 20% of its present production."

Second big problem involved the nature of hydrogen itself. Hydrogen molecules exist in two forms, ortho and para, resulting from different electron spins. In the gas phase at ambient temperature, the equilibrium concentration is about 75% ortho and 25% para, while in the

Unfold Flowsheet ➔

liquid phase the equilibrium is about 99.7% para and 0.3% ortho. If hydrogen were liquefied as it occurs naturally, the exothermic conversion of ortho to para in the liquid would vaporize most of the H_2 even if the vessel were perfectly insulated. Hydrogen must therefore be converted to the para form before liquefaction.

Conversion of ortho to para is carried on in gas phase in presence of a chromium oxide catalyst. Although the chemistry of this reaction was known previously, no large scale units had ever been built. Air Products had to take some "calculated risks" in plant design because of the large scale-up factor, but the gamble paid off.

► **Start With Crude Oil**—Plant uses the relatively standard Texaco partial oxidation process (*Chem. Eng.*, July 13, 1959, pp. 122-125) to make impure hydrogen with CO shift conversion accomplished in two stages. Hydrogen of 98.8% purity flows to the liquefaction section at 100 F. and 325 psig.

To get the oxygen required by the Texaco generators, liquid oxygen from the fractionating column in the adjacent air plant is pumped up to 500 psig. and is vaporized in the nitrogen refrigeration loop to a high-pressure gas at ambient temperature. Refrigeration which was stored in the liquid oxygen is thereby transferred to the nitrogen for use in the hydrogen liquefaction cycle. (Liquid oxygen cannot be used in the hydrogen section because of the danger of leaks which could lead to an explosion.) In addition, liquid and gaseous nitrogen are taken off the fractionating column to supply more refrigeration to the H_2 liquefaction cycle.

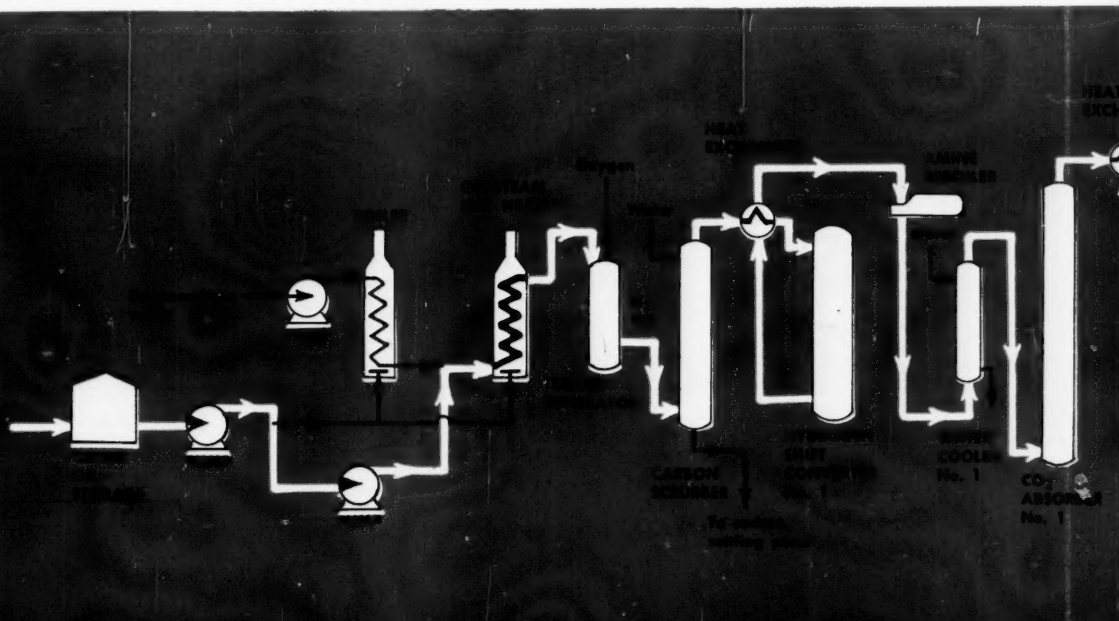
► **Hydrogen Must Be Pure**—Analysis of the gas

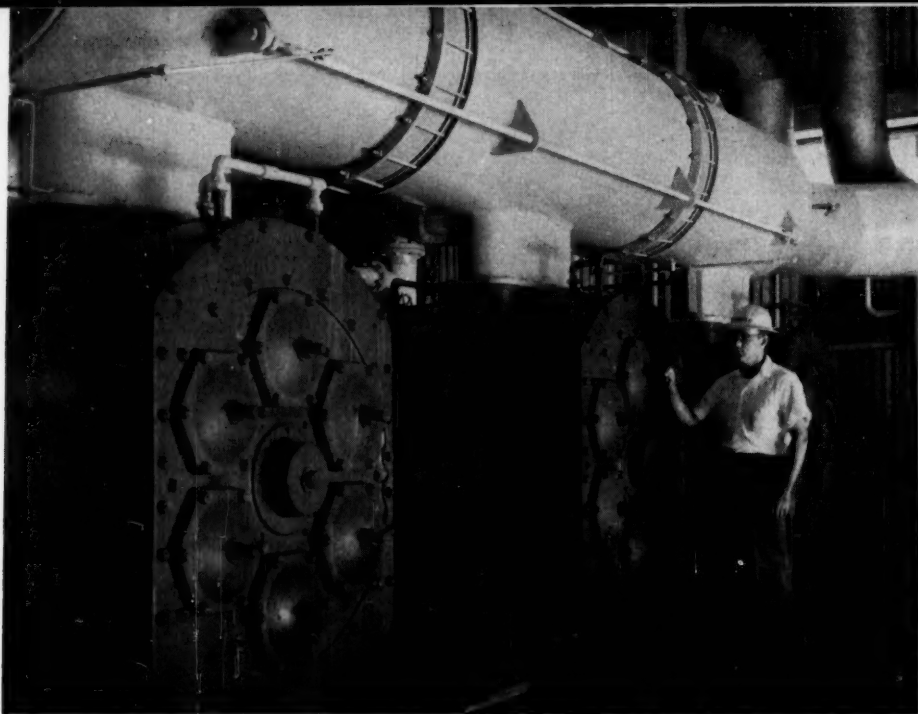
coming into the hydrogen purification section runs 98.8% H_2 , 0.6% CH_4 , 0.3% N_2 and A, 0.3% CO , 0.01% CO_2 and is saturated with water vapor. All impurities must be removed from this stream because at the temperature of liquid hydrogen all foreign material will solidify and clog valves and exchangers.

To start purification, impure hydrogen from partial oxidation section is compressed to 600 psig. It then passes through a silica gel dryer at 40 F. to remove water, then is cooled by a low-pressure (2-5 psig.) hydrogen stream at about -300 F. Methane is absorbed on activated charcoal at -270 F. followed by chilling the gas to -315 F. in a vacuum liquid nitrogen exchanger. At this low temperature, remaining CO , N_2 and A can be adsorbed on silica gel. Resulting hydrogen is believed to be at least 99.9999% pure—no one is really certain because analytical equipment is inaccurate in these low ranges.

► **Finally: Liquefaction**—Purified hydrogen stream goes through a Joule-Thomson exchanger cooled by a hydrogen stream, the gas being above its critical pressure at this point. Conversion of ortho to para-hydrogen carries on in a multistage catalytic converter with intercooling to remove the heat of reaction.

Hydrogen stream again passes through the exchanger, through a Joule-Thomson expansion valve and through a second exchanger where the gas condenses as liquid para-hydrogen at about 2-5 psig. and -423 F. Liquid hydrogen is then piped to storage tanks through a vacuum-jacketed transfer line. From storage, liquid can be shipped by semitrailers or pipeline to the use areas.

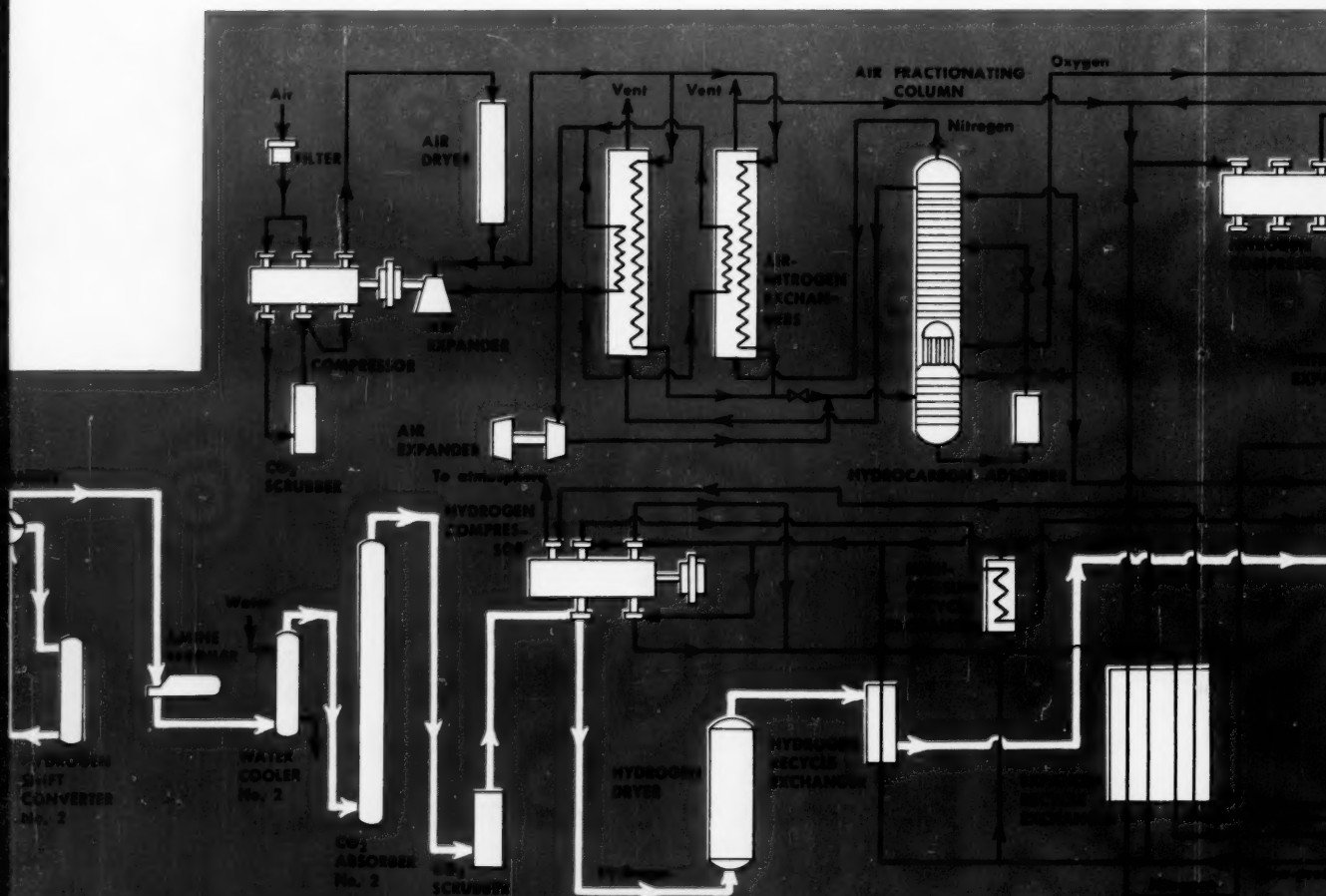


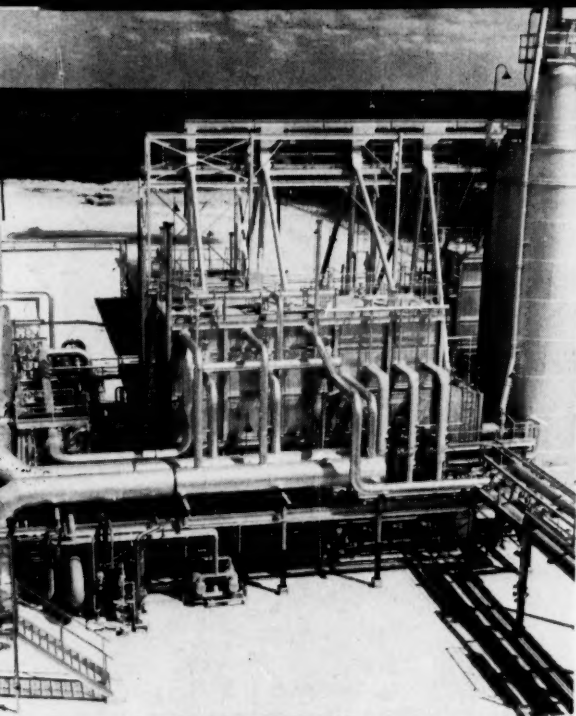


HYDROGEN COMPRESSORS take impure hydrogen from the partial oxidation unit at 325 psig. and boost it to 600 psig. before the hydrogen stream enters the final purification stages.



COLD BOX is where all the

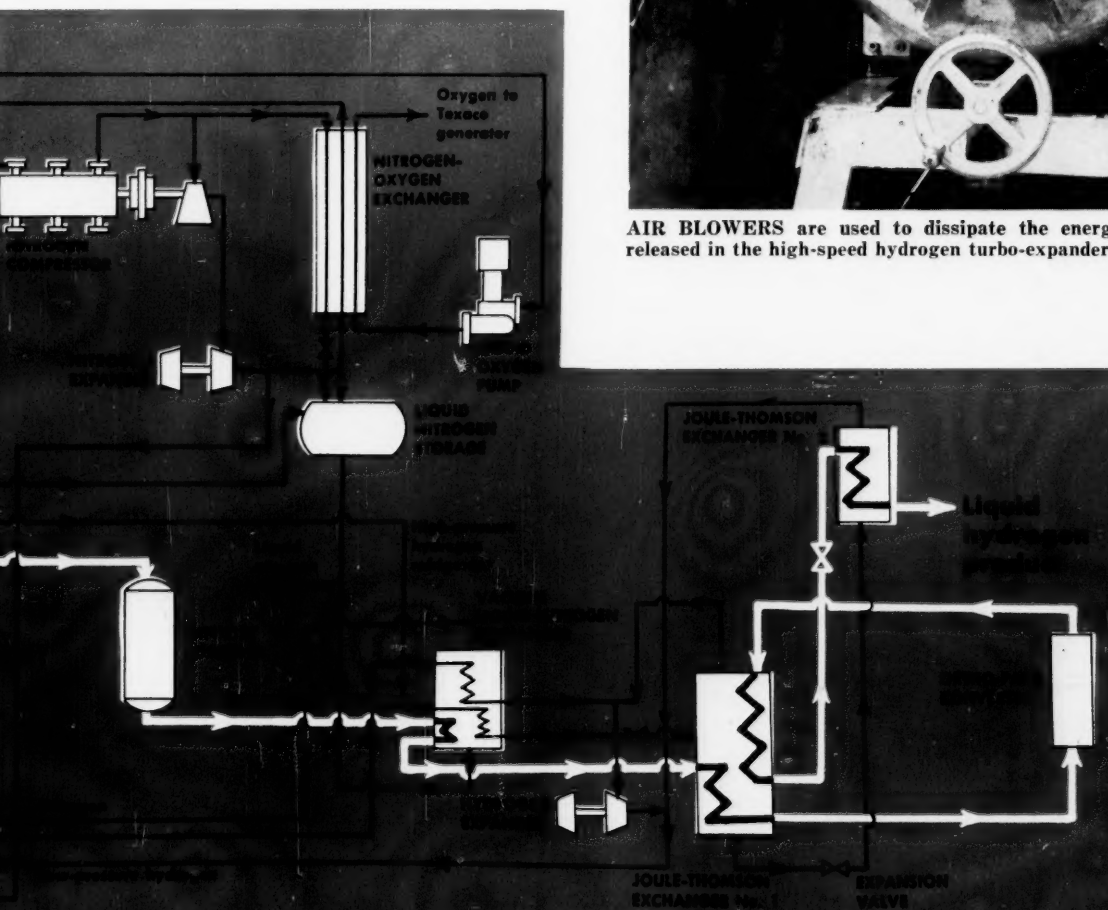




OLD BOX is the heart of the liquefaction process. This is where all the low-temperature heat exchange takes place.



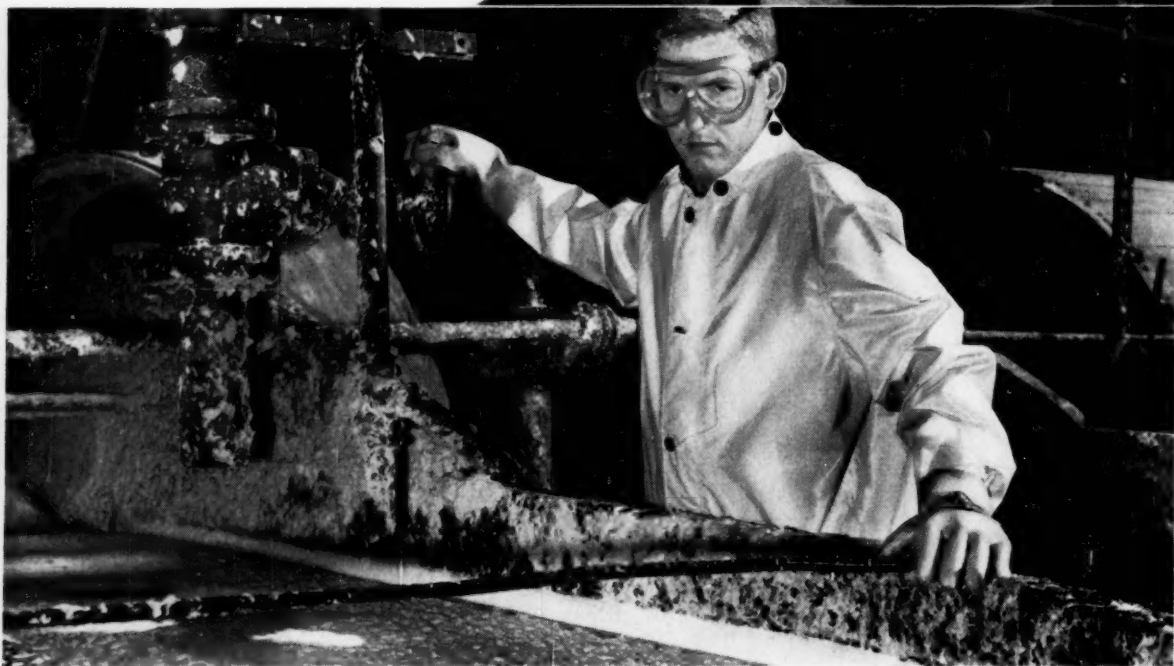
AIR BLOWERS are used to dissipate the energy released in the high-speed hydrogen turbo-expanders.



SPLASH RESISTANT!

One User Called It, "The Only Goggle that ever did the Job!"

This user had searched for three things — (all in one goggle): (1) maximum splash protection (2) coolness and fog-free vision — possible only through adequate ventilation (3) comfort — possible only from light weight, and a soft face contacting mask.



He found all three in the American Optical 710 splash goggle, a product jointly developed by AO and a leading chemical company. Chemical workers like this goggle. While designed without openings in the frame, the indirect ventilation provides double the freedom from fogging of similar goggles. The very light face mask has a smooth-feeling rolled

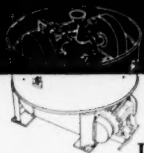
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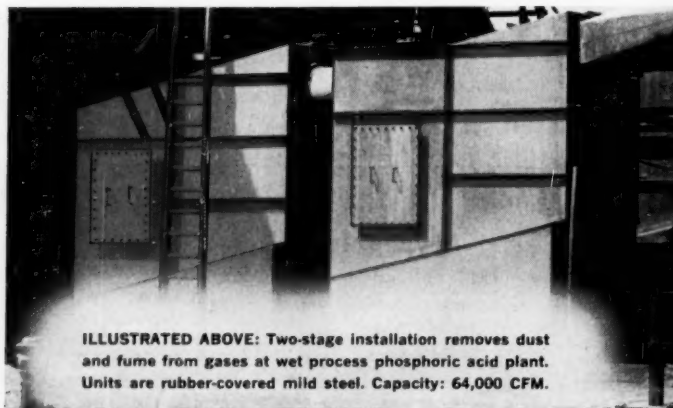
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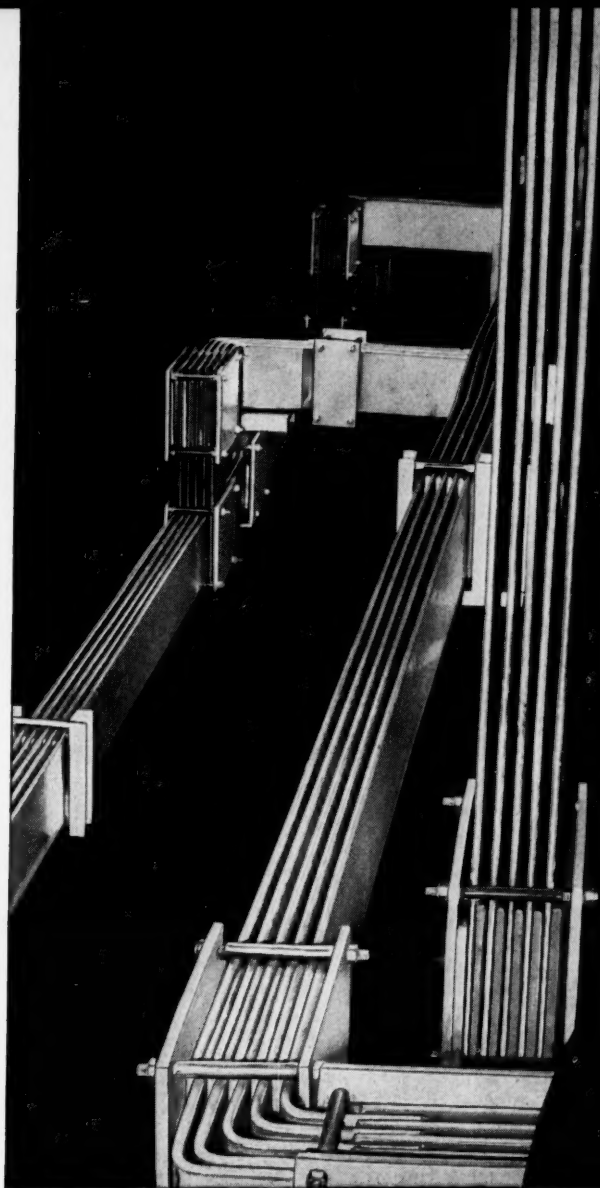
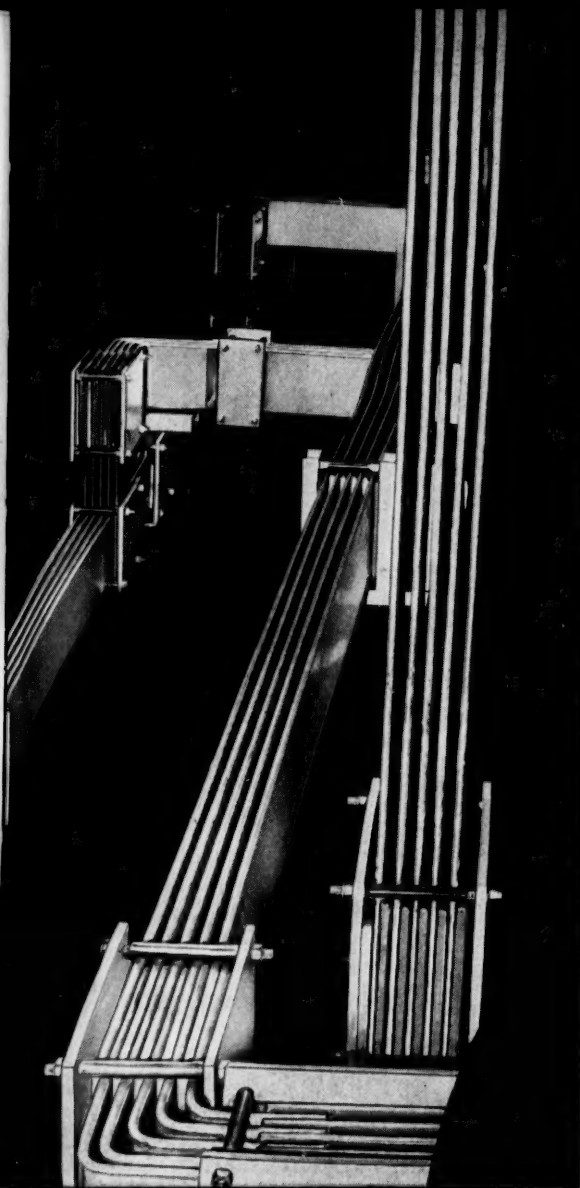
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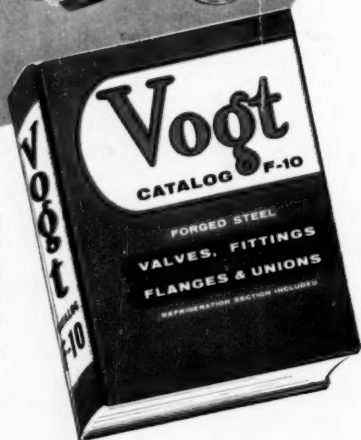
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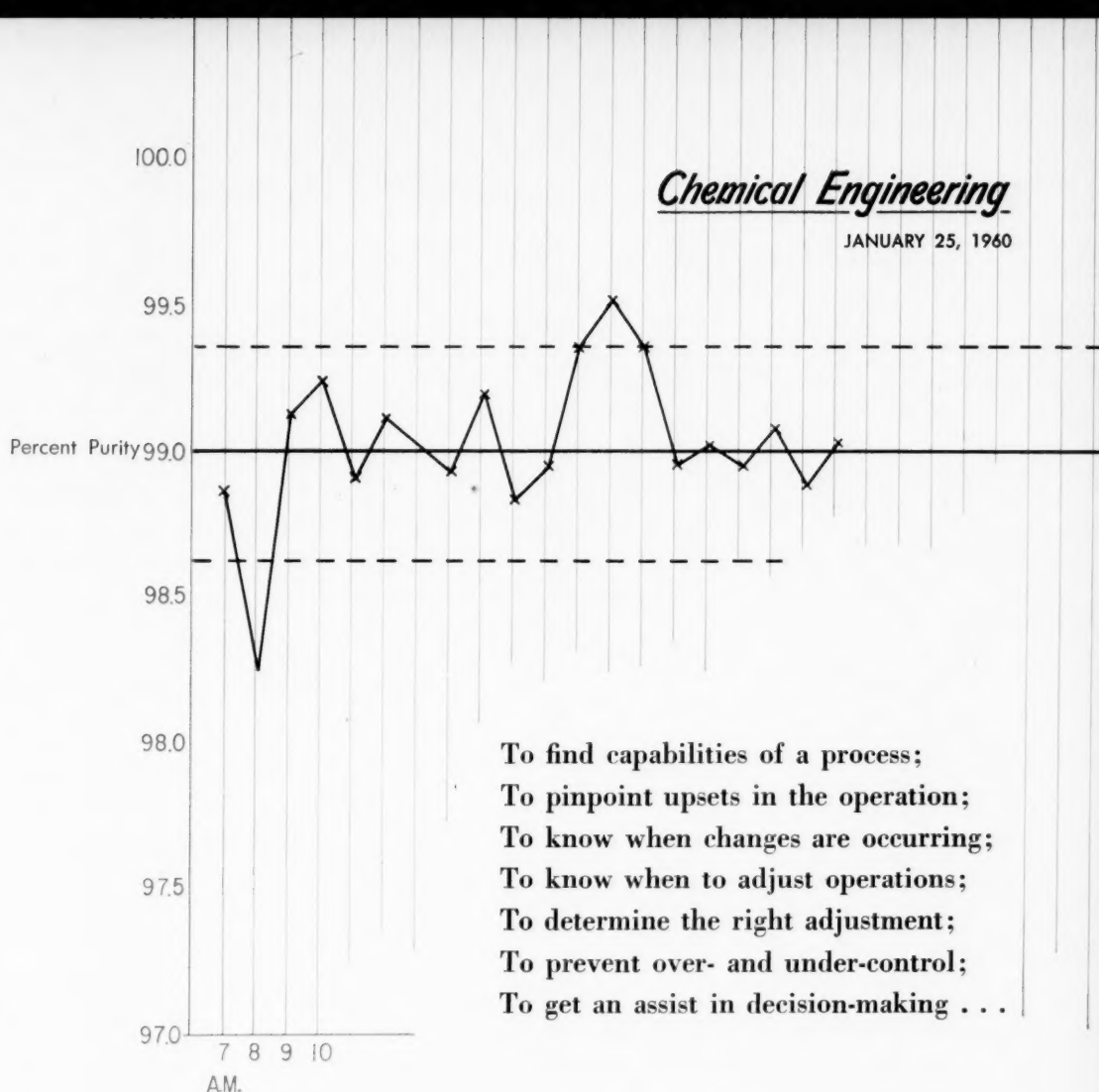
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To get an assist in decision-making . . .

Better Use for Control Charts

E. S. ALDREDGE, Group Leader, Operations Analysis, Process Dev. Dept., Union Carbide Chem. Co., Texas City, Tex.

THE OPERATOR of a continuous chemical process is constantly making decisions about the control of his unit. As product quality is measured, the operator must decide whether or not this quality is at a satisfactory level.

If quality is satisfactory, no change is made in the unit's operation; but, if it isn't satisfactory, a change in some control variable is required to restore quality to its normal level.

Opinions Affect Operations

How the chemical unit operator knows when product quality has changed is our primary problem.

As an example of ordinary procedures,

operating instructions in an olefins plant may read, "hold make purity at 99%." To the shift operator these instructions mean the using units want, say, 99% pure ethylene.

This product quality level is quite normal to the shift operator. After reading the operating instructions at shift change, the operator looks at the last analysis on the log sheet from the previous shift and notes purity was 99.2%. Based on his experience at the unit, instructions from his chief operator, a good calculated guess and perhaps some wishful thinking, the operator probably

This article is based on a paper presented to the Chem. Div. of the American Society for Quality Control in Houston, Sept. 24-25, 1959.

Log Sheet		Date _____
Time	% Purity	Temp
7:00 a.m.	98.9	
8:00	98.2	
9:00	99.1	
10:00	99.2	
11:00	98.9	
12:00 noon	99.1	
1:00 p.m.	99.0	
2:00	98.9	
3:00	99.2	
4:00	98.8	
5:00	99.0	

agrees with himself that 99.2% purity is almost 99.0%, so he decides to make no change in the unit's operation.

After a few hours, ethylene analysis shows 99.3% purity; the question as to whether or not 99.3% is close enough to 99.0% purity must be answered before the operator knows the conditions under which operations should be continued.

Data taken from an olefins plant are shown above. Purities shown are typical of normal operations. Samples are routinely analyzed and results recorded on this log sheet. Based on these results, the operator makes a decision as to how to operate the unit.

... And Opinions Differ

Each of the four shift operators probably has a different opinion as to whether a 99.3% purity is too high. One operator might say, "The purity is all right, let's wait and see what the next analysis is." Another operator might say, "Well, it depends on what the previous analysis was." Whereas, still another operator might say, "99.3% purity is much too high, take immediate action to correct this situation."

Changing the operating instructions to read, "hold ethylene purity between 98.7% and 99.3%" still doesn't completely remove the operator's indecision. Some still look upon the operating instructions as though they weren't binding. Thus, a 98.6% purity might be considered satisfactory.

This last example illustrates the confusion that arises in deciding whether or not process quality has changed. Just as much, or even

Operating Data Often Fit a Normal Distribution Curve

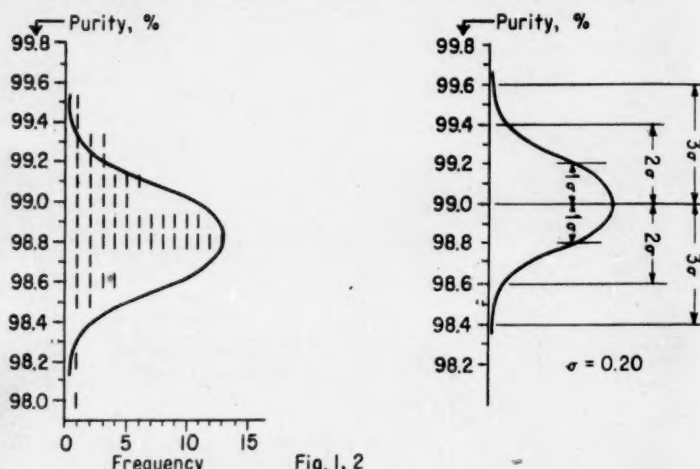


Fig. 1, 2

more confusion results from making an operating change when none is called for by significant process quality changes.

In continuing this example, let's assume the operator thinks 99.3% purity is too high and changes the operating temperature in an effort to lower output purity. If, in reality, output purity isn't different from 99.0%, this change in operating temperature will probably cause quality to go too far below specifications—possibly to 98.4%.

Another correction then has to be made to bring purity back to normal. This type of operation is commonly referred to as "over correction" or "over control" of a process.

Use of the process control chart avoids confusion created in the decision-making just illustrated.

Charts Are the Answer

Purity data from the log sheet are shown in the lead illustration with upper and lower control limits added. Process variation is much more clearly demonstrated on the chart than on log sheets.

Here, control limits act as the operator's decision maker. There's no question as to the required action of the operator. If an analysis plots within the limits, the operator lets the process run as is; if an analysis falls outside the limits, purity is too far from the average so a change

in operating conditions must be

There's no question in the operator's mind as to what to do; the control limits make up his mind for him.

How to Set Control Limits

A brief discussion of control limits and how control limits and process variation are related is necessary for the benefit of those who aren't too closely associated with statistical applications.

As samples of ethylene are collected and analyzed, the results show each analysis differs slightly from the previous analysis. If results are tabulated on a frequency diagram, Fig. 1, the entries in each row begin to form a familiar bell-shaped curve.

Continuing tabulation, the curve becomes well defined, assuming the data are from a normal distribution. In the frequency diagram shown, some of the data points fall outside the apparent normal distribution.

Measure of variability normally used in industrial statistics is variance σ^2 or standard deviation σ which is the square root of the variance. In this case:

$$\sigma^2 = \frac{\sum (x - \bar{x})^2}{n - 1}$$

By calculating standard deviation from a small group of data (30 to

Range Chart Shows You How Fast Quality Is Changing

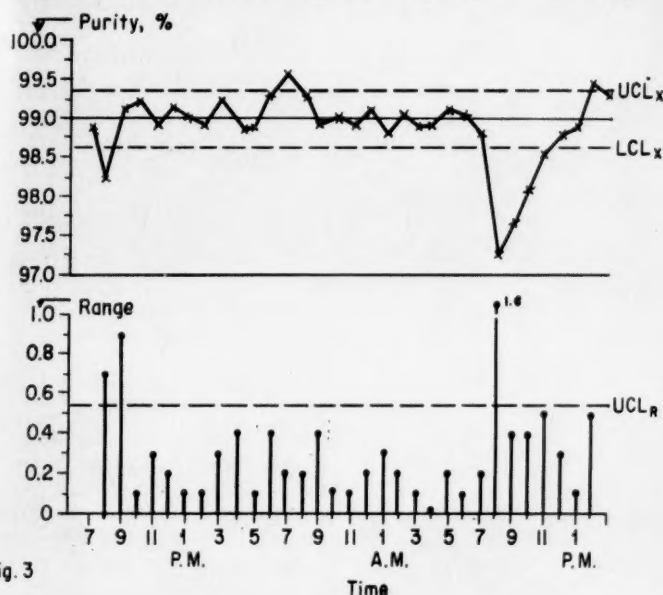


Fig. 3

100 points) you can make an estimate of the distribution of analyses about an average for future production. Knowing standard deviation and referring to statistical tables gives the percent of analyses that should fall between any two limits. Limits for control charts are calculated this way.

Statistical tables show that 95% of all analyses will fall within $\pm 2\sigma$ (1.96 σ , to be precise) of the average analyses and 99.7% within 3σ .

For the data at hand, $\sigma = 0.2$. Thus, 95% control limits are $\bar{x} \pm 0.4$; where \bar{x} is any desired average.

A frequency distribution curve is now drawn to represent the spread of analyses about an average. In Fig. 2, \bar{x} is set at 99.0% so that 95% limits are 98.6% and 99.4%.

This tells us that during normal operation of the olefins plant, ethylene purity should vary between 98.6% and 99.4% due to chance cause alone. Further, if purity is outside these limits, we know that average quality level has shifted due to cause variation and corrective action must be taken.

Cause of the shift in the process average quality may or may not be known, but by using a control variable, such as temperature or pres-

sure, you are able to return purity to normal level.

Process variation is used to set control limits, thus, control limits represent process capability. If you attempt to control the unit at tighter limits, over-control results. If limits are greater than the process is capable of doing, unnecessary quality variation occurs.

Study the Whole Process

Implementation of a process control chart requires a study of the whole process.

As an example, products from many chemical units go into a receiver of some sort. This receiver may be a tank, a bin, or equipment for further processing. Also, many chemical units have large volumes of material in process within the reaction system.

Quantity of material in process, and the point of sampling with respect to the reaction system are important characteristics you must consider. These items affect the lag time between a process change, such as an increase in temperature, and when the full effect of the change is measured in output product quality.

Nomenclature

D_1	Constant ¹
E_2	Constant ¹
LCL	Lower control limit
n	Number of samples
R	Range between consecutive readings
\bar{R}	Mean range
UCL	Upper control limit
x	Individual variable
\bar{x}	Mean variable
σ	Standard deviation
σ^2	Variance

Because of the foregoing, one of the first things to do in setting up a process control chart is to determine the interval for taking samples. If the unit is in operation, sampling interval is already established, but review this interval to be sure it's correct.

If necessary, calculate the initial interval from production unit volumes and throughput rates. In any case, check the interval again after the control chart is in operation.

Lab Tests Affect Variability

Next item of importance is the precision of analysis made by the laboratory. This, most likely, is known from statistical control. If it isn't known, you must determine it.

If laboratory precision is poor compared with quality specification, new laboratory techniques will have to be developed to bring the analysis variation within reasonable control before further work on process control is continued.

It may turn out that most of the process variation is due to variation in laboratory analysis. This doesn't, however, rule out the necessity for a process control chart. Regardless of how unprecise an analysis is, a decision based on it, dictates future operation of the unit.

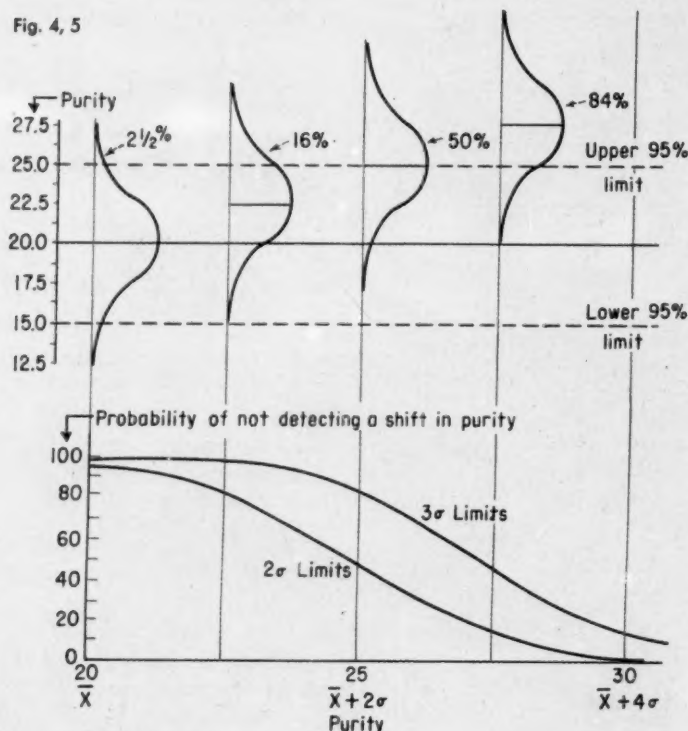
Limits on the control chart include the total variation in the system—variation due to the process plus variation in the laboratory:

$$\sigma_{tot.}^2 = \sigma_{proc.}^2 + \sigma_{lab.}^2$$

Of course, the sample taken must represent production for the period under consideration. All sorts of sampling devices are available; some samples are on a spot basis, others on a continuous basis and still others are a mixture of several spots. Regardless of the sampling

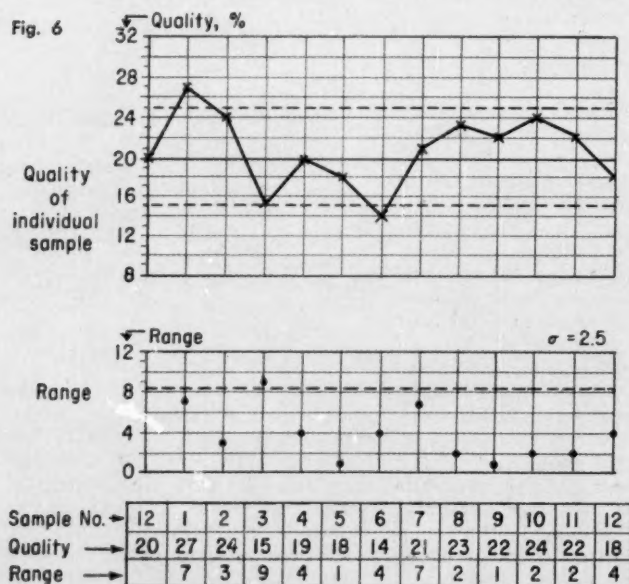
Probability of Detecting Changes Justifies Adjusting the Unit

Fig. 4, 5



Control and Range Charts Can Be Justified in Dollars Saved

Fig. 6



technique, you must conduct tests to assure representative sampling.

Calculate a Moving Range

With the sample interval established and satisfactory laboratory precision demonstrated, you can now calculate control limits.

Moving ranges are first calculated by determining the difference between consecutive individual readings and then figuring the mean range \bar{R} .

Upper control limit for the moving range UCL_R is determined using the relation:

$$UCL_R = D_4 \bar{R}$$

This gives the 3σ (99.7%) limit.

Then, a check is made to see if any of the ranges are outside of the 3σ control limit; if so, they are cast out, and the limits recalculated with the new \bar{R} . This test is continued until no points fall outside the control limit and the corrected \bar{R} is used to calculate the limits for the individual control chart.

Calculations for the data on p. 96 are given below. Constants used to calculate the limits are from Ref. 1, Tables B-2 and B-3.

95% Limits Are More Realistic

When a process control chart is first placed in operation, control limits are set at the 95% level. Limits, normally, are calculated from data collected when the process isn't in complete control. Thus, you can expect an immediate decrease in process variation. After the drop in variation occurs, 95% limits become more realistic than 99%.

For many chemical processes, control limits are maintained at the 95% confidence level after the process is brought under control; for

How to Set Limits

$$\bar{R} = \frac{\sum R}{n} = \frac{9.9}{46} = 0.215$$

$$UCL_R = D_4 \bar{R}$$

$$UCL_R = (2.511)(0.215)$$

$$= 0.54 \text{ (95\% limits)}$$

$$UCL_x = \bar{x} + E_2 \bar{R}$$

$$UCL_x = 99.0 + (1.773)(0.215)$$

$$UCL_x = 99.0 + 0.38 \text{ (95\% limits)}$$

$$LCL_x = \bar{x} - E_2 \bar{R}$$

$$LCL_x = 99.0 - (1.773)(0.215)$$

$$LCL_x = 99.0 - 0.38 \text{ (95\% limits)}$$

others, 99.7% limits are used. Level of the limits depend mostly on the sample interval. If the interval is a long one—one hour or more—95% limits are used; if short, 99.7% limits.

On some occasions, both 95% and 99.7% limits are used. The 95% limit indicates a change is possibly occurring, whereas, a point outside the 99.7% limit indicates little doubt but that the process average has changed.

Enter the Range Control Chart

As already mentioned, the upper control limit for the moving range chart has been calculated. The range control chart is a very important part of the process control chart since it gives a measure of the rate-of-change in a product quality as well as showing a change in process variability.

Where the individual's chart demonstrates average quality level, the range chart shows how fast average quality is changing. A point out of control on the range chart, even though the average quality is still in control, indicates quality is changing at a rate greater than normal.

Use of the range chart is illustrated in Figure 3. The 9:00 a.m. range is out of control (even though purity isn't) indicating the increase in purity is at too rapid a rate. If this increase isn't checked, the next purity analysis will probably be out of control on the chart.

If increased purity is from a known cause, such as a temperature change, you might expect the range to be out of control and make no further change in operating conditions. If the cause for the increased purity isn't known, change operating conditions immediately to prevent a further rise in purity.

How Much Change to Make?

This brings up the point of how much change to make in an independent operating variable such as temperature, pressure, catalyst concentration or flow rate, to bring the dependent variable product quality back into control.

As an example, let's switch from the olefins plant over to an ethanol plant, where we are interested in controlling one of the characteristics of ethanol with a control variable. To accomplish this control, we must

know the effect of the control variable on the dependent variable, or else determine it.

In this case the effect was determined from an experiment conducted at the unit. Results indicate a unit change in control variable causes a unit change in the dependent variable. Thus, if we raise the control variable from 32 to 34 we also increase the value of the dependent variable from 19 to 21.

Knowing the effect of the control variable on the dependent variable, we now restrict the amount of change in the control variable. From experience, we know that as a point goes out of control at the 95% limits level, the maximum change in product quality is one standard deviation. If 99.7% limits (3σ) are used, a two standard deviation change in quality can be made.

We can justify restricting the magnitude of the change in the control variable so as to effect only a 1σ change in the product quality by studying the probabilities of points falling outside the 95% limits, as in Fig. 4.

These frequency diagrams show that the percent of points falling above the 95% limit, increase with an increase in true average quality level. When the true average quality level has increased by 2σ , for example, 50% of the samples of the product show that the quality level is above the original 95% limit.

Shifts in true average quality level are normally slow, (three to five sample periods) so that the shift has something less than a 50% probability of being detected before reaching $\bar{x} + 2\sigma$ —some probability between 16% and 50%, depending on the level of the true average.

Assume the true average shifts only 1σ when a point falls outside the 95% limits. Is it worth taking the risk to make a change in the operating variable? You can only answer this by considering that when a larger 2σ change occurs and you lower the average by only 1σ , the process will be returned to its normal level at a slow rate. This will result in smoother operation.

If, on the other hand, a 1σ change occurs in product quality and you lower the control variable to bring on a 2σ change, quality analyses would begin to fall below the lower control limit. This causes over-control since the 2σ change re-

sults in average quality level bouncing from 1σ high to 1σ low and back again.

Frequency diagrams shown in Fig. 4 can be used to develop operating characteristic curves for a process control chart, Fig. 5.

If 2σ limits are used, the probability of saying that the process average quality has increased (or decreased) is 2.5% even though no change has occurred; likewise, changes in the average of 1σ , 2σ , 3σ and 4σ result in 16%, 50%, 84% and 97.5% probabilities of being detected. Deducting these probabilities from one, the probability of not detecting a shift in process average is obtained. Similar probabilities can be obtained if 3σ limits are being used for control.

A plot of these probabilities is shown in Fig. 5. Here you will note that when 2σ limits are used, the probability of not detecting a 2σ shift in process average quality is 50%. Probability of not detecting a 2σ shift in quality if 3σ limits are used is 84%.

Probabilities justify use of 2σ limits for process control, especially if we operate near the upper (or lower) limit of the quality specification.

Instructions Go With the Chart

The control chart is now ready to use. We normally draw up a different chart for each process. Attempts have been made to standardize on some forms, but each time something different comes up so that a standard form will not normally work.

A typical process control chart is shown in Fig. 6. This control chart is from the ethanol plant and the characteristic being controlled is the same as discussed earlier.

This is a typical process control chart with space provided for recording the quality measured and moving ranges. Control limits are not drawn on the charts, but left for the operator to draw in. Limits can then be moved up or down for any desired change in average quality level.

For these data, standard deviation is 2.5, so that 95% limits are set at 15 and 25.

Along with each new control chart, a set of operating instructions is issued. Some of the items included in the operating instructions are: sample interval, where to

record analyses, what to do if no sample or analysis is obtained, how to calculate the moving range, how to plot results, how much of a change in the control variable to make each time a correction is required and what to do if five or more points fall on the same side of the center line, even though all of these points are within the control limits.

The process control chart is just like a new instrument and it normally requires just as much supervision to see that it's used properly. After a chart is placed in operation, you must follow it closely and discuss mistakes with the operators.

After a short period, usually a week, review the control limits since there's normally a reduction in process variation. Continue to observe the effect of changes in the control variable to be sure that they are in the correct proportion. Also, study sample interval to be sure that this is correct.

In one case, after the control chart was in operation a short time, a study of the operating data indicated the sample interval was too short. There was an indication that changes in the control variable weren't having their full effect until after the next sample was taken.

Tests allowing an increased sample interval verified this point. An increased interval not only gave better control but also reduced the laboratory work load.



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Justify in Dollars

Control chart in Fig. 6 is a good example of how the dollar value of a chart can be calculated. In this case, it was known that another control variable, other than the one used on the control chart, increased the level of the quality measured. At the same time, it increased the unit production rate. Operating specifications for this particular ethanol specified no product above a quality level of 30.

Operation of the unit previously required an alternate control variable held down to be sure no product exceeded specification. Now with the variation in product quality known and controlled, the alternate control variable can be increased, increasing the production rate and holding the upper control limit at the upper specification.

Dollar value of the increased production on an incremental basis is easily calculated and credited to the process control chart.

An Interesting Example

An interesting application is one taken from a different chemical unit. In this case, a process control chart was used to study the cause of variation in one of the characteristics of the product from that unit.

Difference in this process control chart is that the moving average is controlled instead of quality.

Quantity of material in process and lag time involved after a change in the control variable, before its effect could be measured, necessitated a three-period moving average. To obtain a three-period moving average, three consecutive analyses are added together and averaged. When a new analysis is obtained, the first analysis is dropped and the new one added to the previous two to obtain an average. Range is the difference between the highest and lowest of the three analyses.

First job was to determine current variation in order to establish the control limits. This was done using past data and then revised shortly after the control chart was in operation.

Effect of changes in unit control variables was determined and operators trained in the use of these variables. After the process was brought under control, there still seemed too much variation in raw

materials supplied to the unit. A study was made.

This study involved a measure of the difference in raw material quality due to within tank and between tank variation as various mixes were made up. Results showed most of the error was due to between tank variation and very little to mixing. Frequency of analyses of the raw material put into these mixes was then stepped up and tight control placed on the raw material quality.

Over-all program resulted in reduced variation so that the process could normally be controlled well within specifications. Continued use of the process control charts maintained this improved quality.

Charts Are Decision Makers

A review of the main points of this article gives an answer to the question: "Why should process control charts be used for control of continuous chemical processes?"

Control charts act as decision makers for the unit operator—process quality is either in control or out of control. Charts prevent over-control in that uniform changes are made in the control variable. Changes are made neither too soon nor too late.

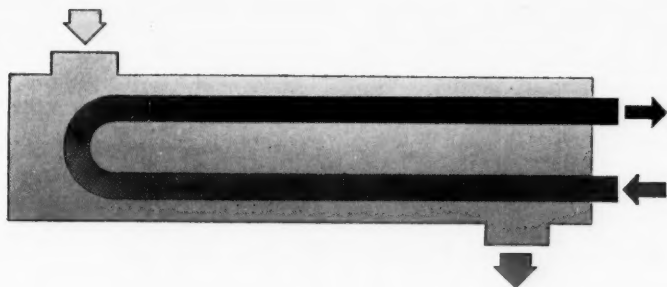
Control charts give a measure of process capabilities so that you know whether or not you can meet specifications and how close to the specification limit the process average can be maintained so the limit isn't exceeded.

What's more, these charts help in studying a process by controlling the main variables so you can observe the effect of lesser variables; also, you can immediately pinpoint upsets in operations so causes can be detected.

Most important of all, process control charts increase profits through improved quality of product, higher production rates and the prevention of product quality giveaway.

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Match Heat Transfer Principles To Your Exchanger Needs

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IN THIS article, we will apply the basic principles developed in our earlier articles¹ on conduction and convective heat transfer. We'll show how these principles are used to match process requirements to the exchangers described in manufacturer's bulletins. Limiting our discussion to tubular units, we find an imposing list that includes categories such as shell-and-tube exchangers, tube banks, double-pipe sections and U-tubes.

On the next page, we discuss the basic characteristics of the many types of heat exchange equipment. In our summary, we discuss criteria affecting service, construction type and mechanical features of heat exchangers as well as factors affecting routing of fluid streams, flow rates and fouling coefficients.

From here on, let's assume that the type of exchanger, diameter and thickness of the tubes, tube layout, fluid routing and all other factors described under the heading of how to select exchangers have been specified. We'll also assume that terminal temperatures and flow rates of the fluids have been given and that our problem is to determine the number of tubes, length of tubes, pass arrangement and, from these, shell diameter and baffle spacing.

Although the details may differ, the general procedure that we'll follow is applicable to almost all exchanger problems including condensers and reboilers.

Example Shows Methods

A hydrocarbon stream, flowing at 50,000 lb./hr. through a tubular exchanger, loses sensible heat and cools from 175 F. to 100 F. Physical properties of the hydrocarbon stream may be taken as those of *n*-heptane as given in Maxwell² or Perry.³ Cooling water at 80 F. is available and leaves the exchanger at 125 F. or lower. Because of its pressure, the hydrocarbon is routed through the tubes.

For safety reasons, leakage is not permissible. Hence, we must use a removable bundle, floating head exchanger. Tubes are copper and are 3/4-in. diameter,

16 gage, 12 ft. long and arranged on 1-in. triangular centers. Assuming maximum allowable pressure drop of 10 psi. for each fluid and using fouling factors given in Table II, let us determine the stock-size heat exchanger necessary for this service.

Step 1—Since the exchange involves only sensible heat and since flow is countercurrent for half of the passes and parallel for the others, the effective temperature difference is less than it would be if counterflow existed throughout. Hence,

$$\Delta T_{\text{effective}} = F \times \Delta T_{\text{lm.c}}$$

The value of F depends on the flow arrangement given in the figures.⁴ Abscissas and parameters of the lines are fixed by the terminal temperatures.

In this example, if the water leaves at 125 F., calculate temperature efficiency P and ratio of temperature change R in the two fluids to find values of F .

$$P = \frac{T_1 - T_2}{T_1 - t_1} = \frac{175 - 100}{175 - 80} = 0.79 \text{ or } \frac{t_2 - t_1}{T_1 - t_1} = 0.47$$

$$R = \frac{t_2 - t_1}{T_1 - T_2} = \frac{125 - 80}{175 - 100} = 0.60 \text{ or } \frac{T_1 - T_2}{t_2 - t_1} = 1.67$$

Either set of consistent values, 0.79 and 0.60 or 0.47 and 1.67 shows the same results. For the 1-2 exchanger, F is less than 0.5 showing it to be inoperable for these conditions. For the two-pass shell arrangement, F is 0.85 which is satisfactory.

Thus, a two-pass shell can be specified or two separate one-pass shells can be used in series to give the same effective ΔT . In this problem, we'll use more water until F for a single shell pass has a value of 0.75 or more. We can find this value by assuming various water outlet temperatures:

t_2	P	R	F
125 F.	0.79	0.60	<0.5
120 F.	0.79	0.53	<0.5
115 F.	0.79	0.47	<0.5
110 F.	0.79	0.40	0.58
105 F.	0.79	0.33	0.71
100 F.	0.79	0.27	0.80

[†] The relatively new Kays-London charts can be used to present the same information. As discussed by Cary,⁵ they have advantages and are simpler to use in certain situations.

* To meet your authors, see *Chem. Eng.*, May 18, 1959.

Using water outlet temperature t_2 equal to 100 F., we find

$$q = 50,000 \times 0.561 \times (175 - 100)$$

$$q = 2,110,000 \text{ Btu./hr.}$$

The amount of water necessary to remove this heat is:

$$2,110,000 = w \times 1.00 \times (100 - 80)$$

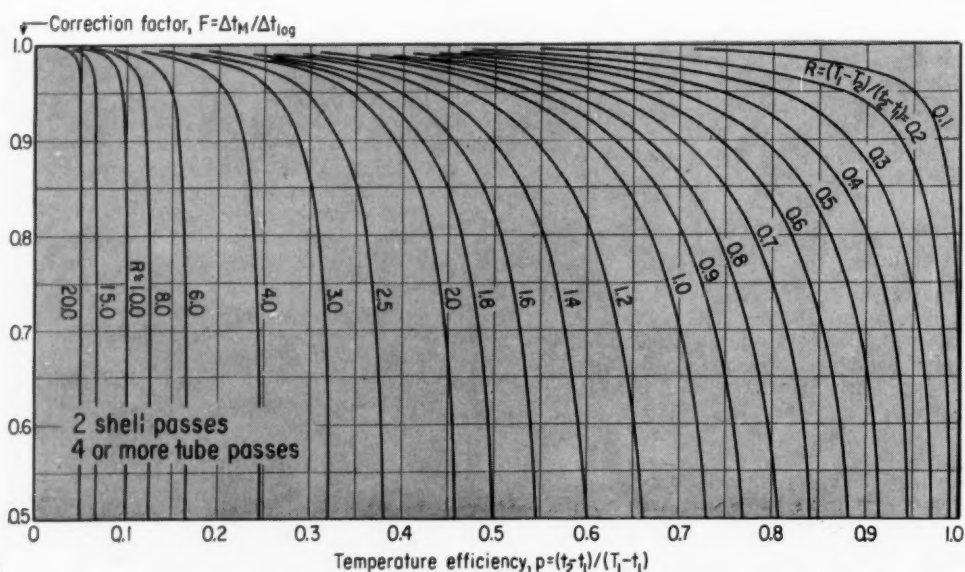
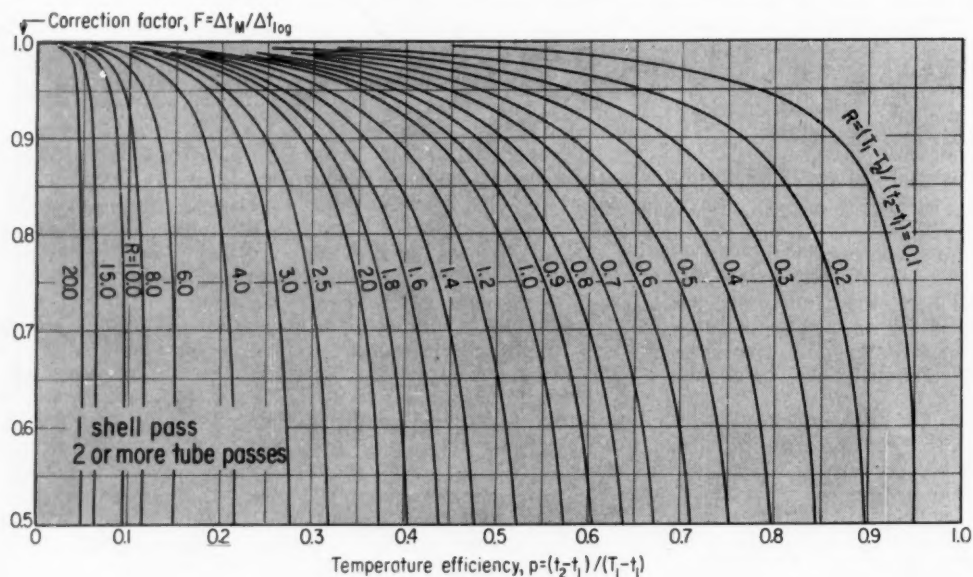
$$w = 105,500 \text{ lb./hr. or 210 gpm.}$$

For terminal water temperature of 100 F. and a value of F equal to 0.80, the effective temperature difference is 33.2 F.

Step 2—Estimate an over-all coefficient of 150 Btu./ (hr.) (sq. ft.) (°F.), based on typical values expected for the individual coefficients. Use this value to find total area required which is $2,110,000 / (150) (33.2)$ or 424 sq. ft. Since the surface area of one 3-in. by 12 ft. long tube is 2.36 sq. ft., the number of tubes becomes $424 / 2.36$ or 180.

From a table of tube counts,^a an 18-in. shell contains 214 tubes in an inside packed, floating head bundle with two tubeside passes or 196 if four tube passes. Use this for the first calculation.

Flow Patterns Govern Log Mean Temperature Difference Correction Factors



Step 3—If two tube passes are used, the velocity at the average temperature is:

$$V_{\text{tube}} = \frac{50,000}{40.5 (0.302/144) (214/2) 3,600} = 1.53 \text{ fps.}$$

If four tube passes are used, the velocity is 3.35 fps. Both seem reasonable. The higher velocity gives a better coefficient, so try it first to see if the tubeside pressure drop is satisfactory.

Tubeside pressure drop equals the sum of the pressure drops through the tubes and headers. For a Reynolds number of 37,400 at an average temperature of 137.5 F., friction factor f is 0.0055. Pressure drop through the tubes is 1.00 psi. from the equation $\Delta P_{\text{tubes}} = 4 f L V^2 \rho / 2 g D$ and pressure drop through headers equals 0.78 from $\Delta P_{\text{headers}} = 4 \rho V^2 / 2 g$ per pass. Hence, total pressure drop is safely within specified limit.

For a nonviscous fluid in turbulent flow, we calculate the heat transfer coefficient which equals 268 from:

$$h = 0.023 (N_{Re})^{0.8} (N_{Pr})^{1/3} k / D$$

Step 4—On the shellside, flow area S at the centerline equals inside diameter of shell less projected width of tubes times baffle spacing. As a first guess, set baffle spacing so that $V_{\text{avg.}} = 3$ fps. Hence, $w = V \rho S$.

$$105,500 = 3 \times 3,600 \times 62.1 (17.25 - 16 \times 0.75) B / 144$$

Baffle spacing equals 4.3 in. or 33.5 sections are needed for the 12-ft. length. Arbitrarily adjust B to 6 in. to give 24 sections and V equal to 2.14 fps. For this spacing check shellside pressure drop. Reynolds number in shell is 15,700 and f_s is 0.13.

$$\Delta P_s = 4 f_s (\text{number of sections}) (\text{length of crossflow path/tube pitch}) \times V^2 \rho / 2 g$$

Substituting in above equation yields a shellside pressure drop of 4.7 psi.

Next, calculate shellside heat transfer coefficient from appropriate j_H factors.^{4,9} For shellside Reynolds number of 15,700, $j_H = 100$. Use the following relation to calculate h , which for this problem equals 1,000.

$$j_H = h_s D_o / k (N_{Pr})^{1/3}$$

Since the shellside coefficient is large as compared with the tubeside coefficient, there is little incentive for increasing the velocity to the maximum permitted by the available pressure drop.

Step 5—Evaluate the over-all coefficient as follows:

$$\frac{1}{U_o} = \frac{1}{1,000} + \frac{0.62}{268 \times 0.75} + \frac{0.065 \times 0.75}{12 \times 220 \times 0.685} + 0.001 + 0.001$$

Since, U_o equals 163, area required becomes 2,110,000/ (163 \times 33.2) or 389 sq. ft. Hence, 165 tubes are required compared to 196 actually used.

Since the over-all coefficient is higher than assumed, a smaller exchanger can be tried. However, the next smaller shell is 16 in. and contains 144 tubes in four

How to Select and Plan Heat Exchangers

To simplify the selection problem, we can group and classify heat exchangers in terms of three criteria:

1. Function or service the apparatus must perform. Common terminology is to call the unit an exchanger if the transfer of sensible heat between two process streams is involved. The unit may be called a heater if a service fluid provides the heat, or a cooler if water or similar cooling medium absorbs heat from the major stream.

Similarly, it is designated a condenser if the major process stream gives up latent heat, and a reboiler or vaporizer if it receives latent heat. It is known as an evaporator if water is the substance vaporized.

2. Construction type. The shell-and-tube design is the most commonly specified unit because it is very economical and can be modified to meet a variety of flow rates and process conditions.

The double-pipe section has only one tube per shell and may be considered as the limiting case of a shell-and-tube exchanger. While its capacity is extremely limited, it has the major advantage that any process requirement can be satisfied by using units in series or in parallel or both.

Tube banks differ from the other types in that they do not have a compartment to contain the service fluid. Use of this type is restricted to air or water service. Where applicable, they are considerably cheaper per square foot of heating area than are shell-and-tube exchangers or double-pipe sections.

3. Mechanical features. Primary considerations are: (1) the method of providing for thermal expansion and (2) the measures used to obtain reasonable velocities and practical tube lengths. Alternatives in the first case are fixed tube sheet, floating head and U-tube exchangers. Major characteristics and comparative features of these exchangers are given in Ref. 2. The number of times the fluids traverse the length of the unit gives the pass arrangement of the exchanger and fulfills the second requirement.

Planning the Exchanger

After the type of exchanger has been selected, several other quantities and operating variables must be specified before the size of the exchanger can be determined. Major factors are:

- Operating pressures of the fluids. In general, the fluid under the higher pressure is put inside the tubes. All other factors being equal, this is the more economical arrangement as it reduces shell thickness.

- Corrosivity of the fluids. Again, as an economy measure, if either material requires a special material of construction it is assigned to the tubeside. In this way only the tubes need be of the more costly material.

- Scaling or fouling tendencies. Because it is easier to clean the inside of the tubes, the worst offender is put inside the tubes. Another reason for this routing is that scale or dirt buildup appears to be lower at high velocities.

- Permissible pressure drops. Pressure drop of the fluid passing through the shell can be regulated more easily by adjustment of the baffle spacing. Consequently, the fluid is usually routed through the shell if this is a limiting factor.

- Heat transfer considerations. Over-all heat transfer coefficient tends to be higher if the more viscous fluid is put on the shellside where turbulence is induced by flow around the tubes. Since the relative magnitudes of the two fluid coefficients is not always predictable, it is frequently necessary to consider both

Normal Design Velocities—Table I

	Tubeside Ft./Sec.	Shellside Ft./Sec.
Water.....	3-6	2-4
Nonviscous liquids.....	2-5	2-3
Viscous liquids.....	2-4	1-2
Gases, low density.....	50-150	30-60
Gases, high density.....	20-80	20-40

routings quantitatively and to choose the one which gives the higher rate of heat transfer and thus gives a small exchanger.

Since routing is an economic problem, alternative exchanger designs must be made and evaluated costwise if the foregoing considerations do not indicate one obvious routing.

The exchanger should be designed and operated at the maximum available pressure drop if all other factors are equal.⁶ Over-all thermal resistance is lower and a smaller exchanger can be selected than is necessary if a lower pressure drop is used. However, caution must be used in applying this concept inasmuch as: (1) pressure drop increases as the exchanger becomes fouled and allowance must be made so that the design flow rate will be maintained; (2) too high a velocity will result in erosion; (3) while fewer tubes or fewer tubes per pass are required, their length or the number of passes required to obtain a given heat transfer may become unreasonable.

Also, it should be recognized that pumping energy must be provided. Hence, it is an economic problem whether to spend more for pumping and less for the exchanger or vice versa. Subject to these considerations, normal design flow rates may fall in the ranges shown in Table I.

The majority of stock exchangers have $\frac{3}{4}$, $\frac{1}{2}$ or 1-in. O.D. tubes. This choice reflects the influence of diameter on pressure drop and anticipated method of cleaning the tubes. Smaller diameter tubes give a higher heat transfer coefficient, all other factors being the same. However, the smaller size has less area per foot of length and carries less fluid per tube. Thus, more tubes are needed.

Normally, exchangers have tubes with heating lengths from 8 to 20 ft. and with from one to eight tube passes. Length is determined by practical considerations such as availability of standard tubes and the floor space allocated to the exchanger.

Design Procedure

Major steps in selecting an exchanger are:

1. A tentative number of shellside passes is set. This is based on the effective temperature difference.

2. Approximate area requirement of the exchanger is determined by estimating the over-all coefficient and applying Newton's law: $A = q/UA\Delta T_m$. Normally, a stock exchanger with a definite number and length of tubes and a corresponding shell diameter is selected to provide this area.

3. A reasonable velocity through the tubes is set. This determines the number of tubes in parallel in each pass. In turn, this fixes the number of tubeside passes required for the total number of tubes assumed in Step 2. Tubeside pressure drop is next calculated and compared with that available. Any adjustments necessary are then made in Steps 2 and 3. Appropriate heat transfer correlation can then be used to determine the coefficient for the established tubeside velocity.

4. Step 3 is repeated for the shellside fluid. The primary variable here is baffle spacing.

5. Individual heat transfer coefficients so found are combined with the tubewall resistances and the fouling factors, if any have been specified, into a new design coefficient. If comparison with the value assumed in Step 2 shows a significant difference in the coefficient or area, Steps 2 to 5 are repeated with the new values.

Although no exact standards have been formulated, values of the fouling factor are normally taken such that the exchanger will stay on stream a reasonable length of time before it must be cleaned. Few data are available on the rate of scale buildup. Typical values for various services are given in Table II.

passes. Similar calculations prove the 16-in. shell to be slightly too small. Therefore, the 18-in. exchanger is used and provides an extra reserve against fouling.

Typical Fouling Factors—Table II⁴

Water.....	0.001 (sea water) to 0.003 (river water)
Hydrocarbons, no phase change.....	0.001 to 0.003
Gases.....	0.002 (air) to 0.01 (flue gases)
Condensing vapors.....	0.0005 to 0.002
Boiling organic liquid.....	0.002 to 0.004

Nomenclature

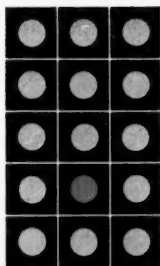
<i>A</i>	Heat transfer area, sq. ft.
<i>B</i>	Baffle spacing, in. or ft.
<i>D</i>	Inside tube diameter, ft.
<i>D_o</i>	Outside tube diameter, ft.
<i>F</i>	Temperature difference correction factor for multipass exchangers.
<i>f</i>	Fanning friction factor.
<i>f_s</i>	Shellside friction factor.
<i>f_f</i>	Fouling factor = $1/h$ dirt and scale.
<i>g_c</i>	Gravitational conversion factor.
<i>h</i>	Heat transfer coefficient, Btu./(hr.) (sq. ft.) (°F.).
<i>h_s</i>	Shellside coefficient, Btu./(hr.) (sq. ft.) (°F.).
<i>j_H</i>	Heat transfer factor, dimensionless.
<i>k</i>	Thermal conductivity, Btu./(hr.) (sq. ft.) (°F./ft.).
<i>N_{Pr}</i>	Prandtl number.
<i>N_{Re}</i>	Reynolds number.
<i>P</i>	Temperature efficiency, see figure.
ΔP	Pressure difference, psi. or lb./sq. ft.
<i>R</i>	Temperature change ratio, see figure.
<i>S</i>	Flow area, sq. ft.
<i>T</i>	Temperature of hot fluid, °F.
<i>t</i>	Temperature of cold fluid, °F.
ΔT	Temperature difference between streams, °F.
ΔT_{\log}	Logarithmic mean average temperature difference assuming countercurrent flow. Also, ΔT_{\log} .
ΔT_{eff}	Effective average temperature difference for actual flow arrangement. Also, ΔT_m .
<i>U</i>	Over-all heat transfer coefficient, Btu./(hr.) (sq. ft.) (°F.).
<i>V</i>	Velocity, ft./hr. or fps.
<i>w</i>	Weight rate of flow, lb./hr.
ρ	Fluid density, lb./cu. ft.
μ	Fluid viscosity, lb./hr.-ft. or lb./sec.-ft.

Subscripts

1	Inlet conditions.
2	Outlet conditions.
<i>t</i>	Tubeside.
<i>s</i>	Shellside.
<i>o</i>	Based on outside area.

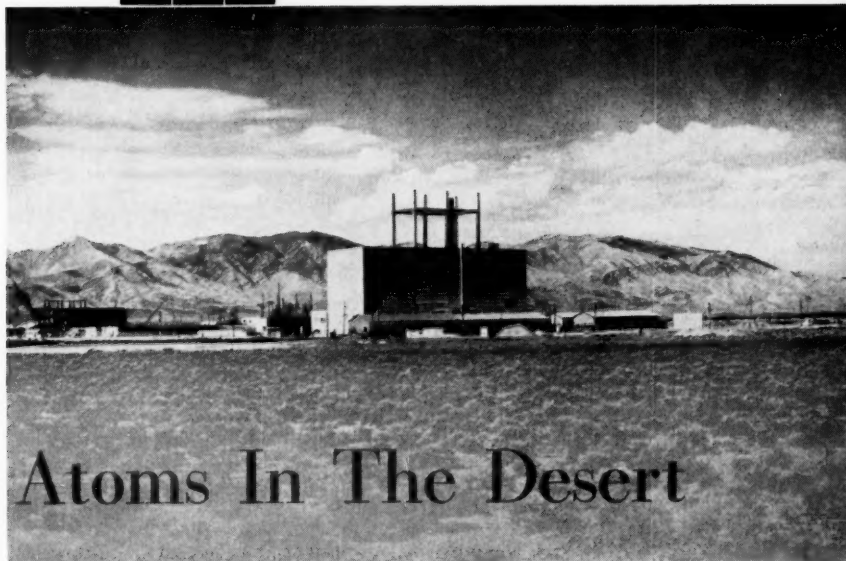
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Atomic

Fuel Processing: Part III



Idaho Falls: Atoms In The Desert

This new reactor is only one of dozens for which the Idaho Chemical Processing Plant will process fuel.

SIXTY miles west of Idaho Falls and seventy miles northwest of Pocatello, Idaho, is the AEC's National Reactors Testing Site (NRTS). In this uninhabited 2,000 square miles of desert is the largest known concentration of nuclear reactors in the world, but so large is the site and so dispersed are the individual reactor facilities, the casual visitor is likely to see nothing but desert.

Nobody lives at the site. Employees of Phillips Petroleum Co., who operate the facilities for the AEC, live in Idaho Falls or Pocatello and commute by special bus. The trip takes an hour or less.

Among the facilities at the site, seemingly alone in the desert, is the Idaho Chemical Processing Plant (ICPP), one of four AEC processing sites that will take part in processing fuels from civilian power reactors. ICPP was originally designed for processing highly enriched fuels from the various test reactors at NRTS.

Now, however, the plant will also process fuels from numerous civilian reactors in addition to its normal NRTS load. In all, ICPP will be processing fuel from some 40 different reactors from all sections of the country and from at least one reactor in Europe.

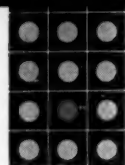
This is the Belgian Test Reactor which is being constructed for Euratom.

The plant area contains five buildings and an underground tank farm for the storage of radioactive wastes. Principal buildings are the main process building and laboratory, fuel storage building located on a railroad spur, waste processing building and a utilities building.

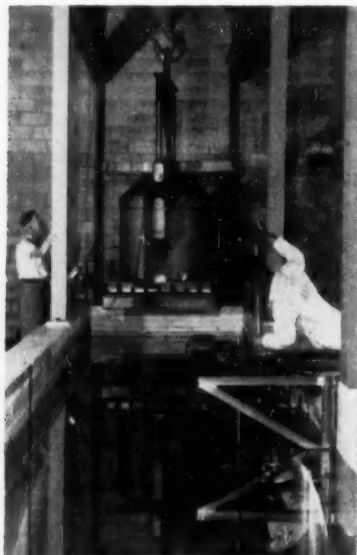
We will discuss the fuel storage building first.

Fuel Receiving and Handling

The distinguishing features of the fuel storage building are the



Spent Fuel Goes Underwater



transfer and storage canal and basins. A canal 200 ft. long, 7 ft. wide and 21 ft. deep runs the length of the building. Two storage basins 40 ft. by 60 ft. by 21 ft. extend at right angles at the middle and north sections of the canal. Another storage basin 40 ft. by 80 ft. by 21 ft. is at the southeast end of the canal. Loading and transfer pits 7 by 25 ft. extend from the canal opposite the storage basins. These loading and transfer pits are further sub-divided into two identical loading pits 6 by 9 by 26 ft. deep adjacent to a transfer pit 6 by 7 by 21 ft. deep.

A 15-ton crane travels the length of the canal, servicing the smaller storage pits and the loading and transfer pits. Both a 75 ton and a 15 ton crane service a railroad track adjacent to the larger storage basin. Another crane of 1-ton capacity services this storage basin directly.

No small part of fuel handling at ICPP is water treatment. The storage basins and canal contain a total of about 1,500,000 gal. of water which must be kept clean. The water is treated with 250 ppm. of sodium nitrate to inhibit corrosion of underwater structures, but corrosion is not the main problem. When water conditions are optimum, micro-organisms multiply

rapidly causing cloudiness. Organic slimes filtered from the water tend to plug the filters requiring more frequent backwash and eventual replacement of the filter stones. At times, the basin water is shock treated with chlorine above the regular treatment of 0.1—0.2 ppm. Also, sodium nitrate corrosion treatment is temporarily stopped as some of the organisms feed on the nitrate ion.

In general, however, water treatment has been satisfactory as the basins have been in service for eight years without being drained and cleaned. Only a thin layer of dirt $\frac{1}{4}$ to $\frac{1}{2}$ in. thick has accumulated on the floor of the basins. An underwater vacuum cleaner designed to remove this dirt is now being tested.

Buildup of radioactivity in the storage basin has not been a major problem. However, storage of large amounts of unclad alloy-type fuel for long periods of time would undoubtedly cause the water activity to rise.

Also in the fuel storage building is a hot cell for mechanical processing of some fuels. This cell is 31 ft. long, 10 ft. wide and 14 ft. high with 5 ft. thick concrete walls and four glass viewing windows. A tunnel runs beneath the cell for removal of the cut fuel elements to the processing area.

Depending on the size of the fuel shipping cask and the type of fuel, the incoming fuels will be handled at the large storage basin or the smaller ones. In either case, the method of opening the casks is essentially the same. After removal of cask tiedown lugs and lid bolts, the cask is picked up with the crane and lowered into the transfer basin. The photo above left shows a small cask being lowered into a transfer basin for opening and unloading. About 11 ft. under the water, the cask lid outriggers engage a holding beam which suspends the cask lid while the cask is lowered to the bottom of the basin. The cask then moves laterally from beneath the lid. Here the methods for handling large elements and small elements diverge.

In the case of small fuel elements, a section of monorail over the loading pit is suspended from a hydraulic cylinder so that a bucket yoke or hook can be lowered into the cask and a full bucket of elements removed. The elements go to the

central transfer pit, are identified and transferred with tongs into a storage bucket. (In some instances, the shipping bucket can also be used as a storage bucket eliminating extra handling of the elements.)

Where large elements or large casks (up to 75 tons) are handled, the facilities at the large storage basin are used. After removal of the cask lid, the 75 ton crane moves clear of the cask and a jib track for the one ton transfer crane is lowered over the cask. The transfer crane removes the loaded fuel magazines or containers from the cask and places them in storage in the basin.

The transfer crane also delivers loaded magazines to a magazine unloading table on the floor of the basin at the rear of the hot cell. Here, two parallel endless chains with fingers run from the magazine unloading table up through a submerged slot in the rear of the cell and deliver the fuel elements into a feed trough in the cell.

A push arm pushes the fuel element through a hydraulically operated press and shear which is capable of crushing and/or shearing simple elements.

Everything in the hot cell is done by remote control. There is an elaborate ventilation system and also steam and water sprays for decontamination and removal of particulate matter. Operations are observed through shielded windows. There is a General Mills Manipulator which can traverse the whole cell. There is also provision for installation of Argonne Model 8 Master Slave Manipulators.

Cut up fuel leaves the cell in buckets through the tunnel under the cell and goes to the process building for chemical processing.

All mechanical equipment needs maintenance sooner or later. Equipment handling radioactive materials is no exception, but it presents some special problems. Maintenance on the General Mills Manipulator itself has been done by removing it from the cell and repairing it outside, but just getting it out can be a problem. For this purpose and for other in-cell maintenance, ICPP built a shielded box with 4 in. thick lead walls, a 6 in. thick viewing window and a hinged rear door for access. The box is provided with a forced air ventilation system and a communication system. When maintenance in the cell is required, the

15-ton crane lowers the box with a man inside into the cell. Some maintenance jobs are done with a tong while others are done directly through the armholes taking advantage of the relatively high permissible exposure for the hands.

All fuel transfers between the storage building and the processing plant are made by 15 ton capacity straddle carriers, many of which also serve as fuel chargers to the dissolvers. These charger-carriers have stainless steel, lead shielded motor driven drawers for discharging the elements directly to the dissolvers. Fuel can be picked up in the tunnel under the hot cell and transported directly to the dissolvers without handling the individual elements, thus greatly reducing the work required for small fuel elements.

Fuel Types

Let us now discuss some of the fuel types that are and will be processed at the ICPP.

A potential fuel processor must know the following about the fuels he intends to handle: (1.) the principal structural material, which determines the acid required; (2.) shape, weight and over-all dimensions which affect handling means and dissolving vessel suitability, and (3.) uranium content which determines process capacity.

► **Plate Type Aluminum Fuels**—More than half the fuels processed at the ICPP will be of this type, consisting of 10 to 19 flat or curved plates of aluminum clad aluminum-uranium alloy (13 to 26% uranium) contained in a box type aluminum assembly. Though there are many minor variations in these fuels, most of them can be reduced to a length of little over two feet by removal of end boxes containing no fuel. Such removal of excess aluminum is highly desirable since each kilogram of aluminum dissolved requires a volume of storage space for highly active waste costing about \$15.

The normal assembly with ends removed weighs about 4 kg. and may contain 140 to 220 grams of highly enriched uranium. There are a few reactors with similar but longer fuel assemblies containing up to 400 grams of enriched uranium.

► **Tubular and Other Aluminum Fuels**—Three reactors have fuels

consisting of concentric tubes, the disassembly and handling of which should introduce some unique problems. These fuels vary in length from 27 to 48 inches with up to 6 concentric tubes in each assembly. Uranium content ranges from 110 to 220 grams.

The Brookhaven graphite reactor has a 24 inch long element which is not a tube but three plates bent and welded into a star shape with recurved fins extending outward for an effective diameter of 2.5 in. This element contains only 15 grams of uranium. Still other fuels are thin discs on a spindle, and aluminum clad rods only 8 in. long.

► **Zirconium Fuels**—One of the largest fuel elements is the zirconium-uranium element from the Shippingport reactor. This element is similar to the plate type aluminum fuels but much larger and composed principally of Zircaloy-2. The assembly consists of four plate-type subassemblies grouped to form a box 5.5 in. on a side and about 6 ft. long with end sections removed. The plates are composed of an alloy of Zircaloy-2 and 6.3% uranium clad with Zircaloy-2. This element contains 2.5 kg. of highly enriched uranium and 127 kg. of Zircaloy.

► **Stainless Steel Fuels**—Highly enriched uranium-stainless steel fuels generally consist of a matrix of a sintered mixture of stainless steel and uranium dioxide powders, clad with stainless steel and formed into a suitable structure. Of the five fuels with which the ICPP is concerned, four are plate-type and one is tubular.

One version of the proposed superheater for the Northern States Power reactor has assemblies of two concentric stainless steel clad tubes. These tubes are 6 ft. long and contain 79 grams of UO_2 and 255 grams of stainless steel.

You can see that the variety of fuel elements and materials is considerable, requiring a versatile plant to handle all of them.

ICPP a Versatile Plant

The Idaho Chemical Processing Plant is a flexible, multi-purpose plant designed to process enriched uranium reactor fuels. It is multi-purpose in that, although initially designed for processing aluminum alloy fuels in a batch dissolving Hexone three cycle extraction sys-

tem, it can also process zirconium and stainless steel fuels. This capability was added later with equipment for dissolution and tri butyl phosphate (TBP) extraction of these fuels. Equipment was also added for continuous dissolution and TBP extraction of aluminum fuels and a small dissolver was provided for essentially unalloyed highly enriched uranium fuels. For most fuels and operating conditions, the continuous dissolution system can be operated at greater efficiency than the batch system.

The plant is flexible in that by interconnection of the dissolving and extraction equipment, as well as by use of special means for storage and handling of fuels, it can handle a wide variety of special shapes and compositions.

Fig. 1 is a schematic layout of the processing cells in the processing building. Solid lines indicate the normal flow of material through the processes, dotted lines show alternate paths. Note that these are parallel head end processes leading to a common Hexone extraction cycle.

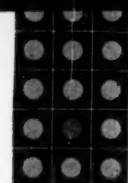
What Are the Processes?

Metals used for fuel cladding and alloying—aluminum, zirconium or stainless steel—determine the dissolving reagents and initial extraction process throughput. Thus the various processes are based on the solubility of the fuel diluent metals whose solutions are carried through to the waste streams. Here is a brief run-down of each of the ICPP processes for the fuels described earlier.

► **Aluminum Alloy Process**—There are two aluminum fuel systems at Idaho, a batch system and a continuous system. The batch system is the older of the two and has the smaller capacity, three kg. of uranium per day. The continuous system has a much higher capacity, requires fewer operators, fewer laboratory analyses, and uses less chemicals per unit of fuel processed through it.

The aluminum process, as are all the ICPP processes, is a total dissolution process; both the aluminum cladding and the uranium fuel are dissolved in one operation.

A charger-carrier brings fuel from the storage building and drops it into a charging cave. Here, a remote handler picks up the elements



Processing Building Cell Layout Shows Flexibility of Plant

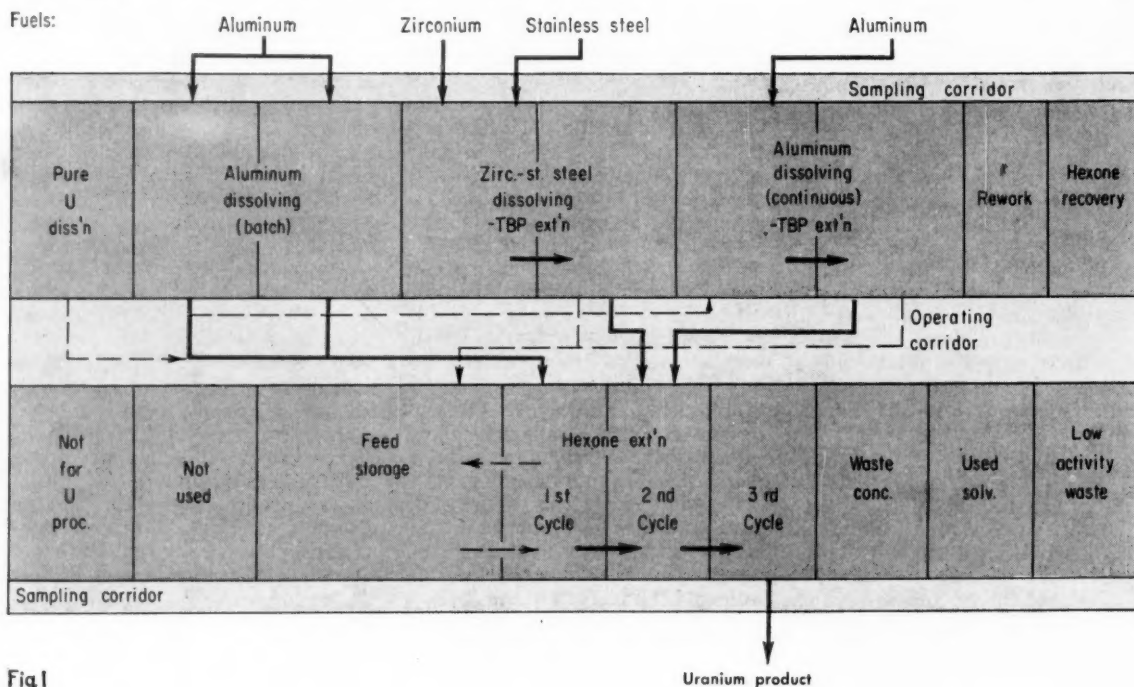


Fig. 1

and drops them into the dissolver. In the dissolver, 6.3 molar nitric acid with about 0.007 molar mercuric nitrate added as a catalyst dissolves the elements. Oxygen enriched air introduced to the bottom of the dissolver during dissolution converts part of the nitrogen oxides back to nitric acid, thereby reducing acid consumption to 3.25 mols per mol of metal dissolved.

Continuous processing is done in equipment that looks more like pipes than vessels. The dissolvers, there are two of them, are 26 ft. long but only 7½ in. in diameter over 16 ft. of their length. Extraction columns accompanying the dissolvers are equally slim with such dimensions as 23 ft. long by 10 in. in diameter, 16 ft. by 8 in. and 18 ft. by 9 in. Feed, transfer and run tanks are more conventional in that they are 4 ft. in diameter by 8 ft. high.

Batch processing is carried out in more conventional appearing equipment. Dissolvers are 3 ft. in diameter with a capacity of 600 liters.

Chemical concentrations in the batch process are different from the

continuous process. The batch system uses 5.33 molar nitric acid with 0.004 molar mercuric nitrate catalyst. Dissolution takes about three hours. Regeneration of nitrogen oxides makes the net acid consumption about 3.6 mols per mol of metal dissolved.

► **Zirconium Fuel Processing**—The zirconium head end at the ICPP was designed for processing fuel from the Nautilus (SSN 571). It consists of a single batch dissolver and a set of first cycle TBP extraction-stripping columns. These columns also process stainless steel fuel.

The process is quite simple. Fuel and 100 liters of water go into the dissolver and 10 molar hydrofluoric acid is metered in over a period of several hours. After a short period of induction, the reaction proceeds vigorously, limited only by the acid addition rate. One molar nitric acid follows the hydrofluoric acid to oxidize the tin contained in Zircalloy-2.

► **Stainless Steel Processing**—The zirconium and stainless steel processing equipment were built at the same time, the stainless steel process being designed for fuel from Seawolf. Different dissolvers are used for the stainless fuels, but all

Total Dissolution Needs Powerful Reagents, Two Extractions

Reagent	Aluminum Fuel	Zirconium Fuel	Stainless Steel Fuel
Dissolving	Nitric Acid Mercuric Nitrate	Hydrofluoric Acid —Nitric Acid	Sulfuric Acid —Nitric Acid
Complexing—salting	Aluminum Nitrate (from fuel)	Aluminum Nitrate	Nitric Acid
First extraction	TBP or Hexone	TBP	TBP
Final extraction	Hexone	Hexone	Hexone

other equipment is common to both fuels. Thus it is not possible to process both fuels at the same time.

The stainless steel dissolver is essentially a 5.5-in. pipe 24 ft. long suspended from the ceiling of the processing cell. Fuel drops directly into it from the charger through the 5 in. throat of the slide valve which closes off and shields the dissolver.

The only fuel processed in this system at the present time is that from the Organic Moderated Reactor Experiment (OMRE), a rather special case. This fuel comes encrusted with a carbonaceous coating from the reactor moderator and thus must be cleaned up before actual dissolution begins. This cleaning is done with a caustic-potassium permanganate solution in the dissolver, after which the cleaning solution is discharged to waste and the dissolver is washed with water.

Forty liters of 6.5-molar sulfuric acid dissolve the stainless steel with the aid of a pad of steel wool to trigger the reaction. At the end of three hours at boiling, the dissolver is cooled and 20 liters of 6-molar nitric acid dissolve the uranium exposed by dissolution of the stainless steel. The solution is again heated to boiling, cooled, then transferred to the coarse feed adjustment tank where it is treated with concentrated nitric acid.

Addition of nitric acid to the dissolver passivates any undissolved stainless steel. Therefore, the dissolver is washed free of nitrate ion and a second cut is made. The solution from the second cut is added to the first and the solution is transferred to the fine feed adjustment tank as column feed.

Solvent Extraction

Solvent extraction of the dissolver products follows dissolution. There are two solvent extraction processes at the ICPP; extraction with TBP (tributyl phosphate) and Hexone (tri-isobutyl ketone). These are known respectively as the Purex and Redox processes.

TBP in a kerosene base does preliminary cleaning up of the solutions. The Hexone does the final purification, yielding purified, decontaminated uranyl nitrate.

Batch aluminum dissolver product normally goes through the Hexone system only, the other solutions being extracted first with TBP, then Hexone.

Fig. 2 is the flow sheet for TBP extraction of aluminum fuels from the continuous aluminum process. It is, however, essentially similar to the flowsheets for TBP extraction of the zirconium and stainless steel fuels.

Critically

ICPP has several approaches to critically safe operation: limitation of batch size, careful geometric design, and concentration limitation of solutions. This control extends not only to equipment which normally contains uranium, but also to equipment that should not contain uranium but because of mishaps may do so.

The major items of concern with respect to nuclear safety are the batch dissolvers. Each dissolution in a dissolver leaves a heel which must be removed periodically to prevent accumulation of a critical mass. A statistically designed chart for each dissolver determines when an allowable quantity of uranium has accumulated. At this point, repeated dissolutions are made without the addition of fuel until the dissolver is empty.

Present practice does not permit more than 1,700 grams of uranium in the zirconium dissolver at one time, this being the minimum

amount of U^{235} that can go critical when contained as a homogeneous solution in a 23½-in. diameter vessel—the size of the dissolver. Similar precautions are taken with other dissolvers.

Extraction columns are generally infinitely safe by reason of their very small diameters, as little as 1½ in. Some solutions, notably from the continuous aluminum process, are infinitely safe by reason of the large quantity of inert cladding material contained in them. Some non-safe areas, such as the vapor disengaging space of the first cycle product evaporator are protected from accumulating a critical mass by an overflow line.

Waste Disposal

Liquid wastes are stored in 13 stainless steel vessels which are located in underground concrete vaults. Nine of these vessels, for aluminum wastes, are 300,000 gal. capacity each; the other four, for zirconium and stainless steel wastes, are 30,000 gal. vessels. Six of the first cycle aluminum waste tanks have cooling coils to keep the temperature below 55 C. It takes 4 to 5 years for the fission products to decay sufficiently so that cooling is no longer required.

First cycle aluminum wastes are

TBP Extraction of Aluminum Fuels Is Similar to Zirconium, Stainless

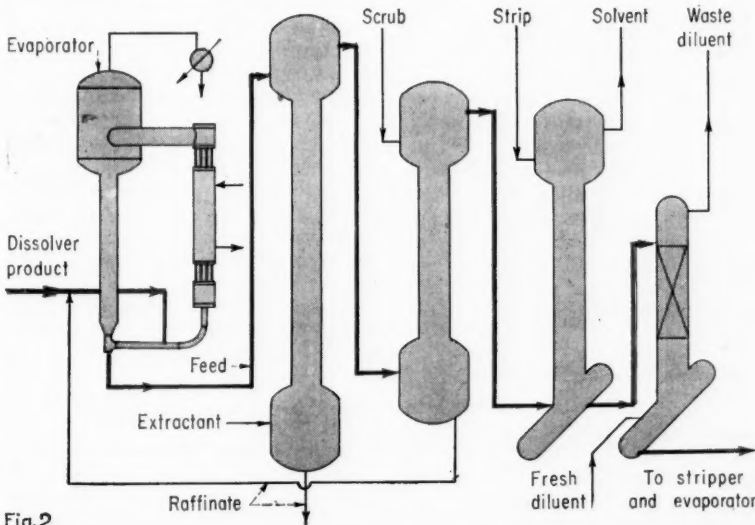
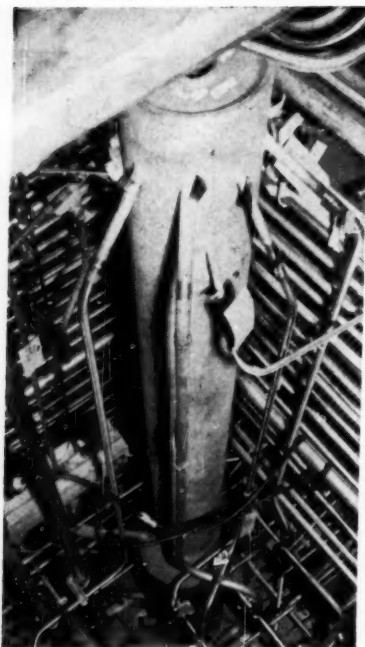


Fig.2

Dissolver Resembles Column



evaporated before storage, but zirconium and stainless steel wastes are not.

ICPP is now building a fluid bed waste calciner which should be completed about mid-1960. Design capacity is about 60 gal. of wastes per hour. Nitrates will be decomposed and discharged to the stack; aluminum and fission products will be converted to the oxides and stored as solids. There should be an over-all volume reduction factor of about eight compared to the present liquid waste disposal.

Corrosion experience with the waste disposal tanks has been excellent. For instance, design life for the zirconium waste storage tanks was 10 years, but corrosion samples exposed to wastes in one of the tanks indicate that their life should be 35 to 40 years.

Materials of Construction

Different processes confined to single purpose equipment permit a flexibility in the choice of materials that would not otherwise be possible. The zirconium dissolver, for example, is Monel while the stain-

less steel dissolver is Carpenter 20. Much of the auxiliary equipment is constructed of Carpenter 20, but there is also wide use of Types 347 and 304 L stainless steel.

The extremely corrosive nature of the processes indicates short equipment life despite the use of special materials. Preliminary corrosion work with the zirconium process dissolver showed a possible 2,700 hr. life. However, later observations are that this may be stretched to 18,500 hr. The small amount of nitric acid used to dissolve the tin in Zircaloy is more corrosive to the dissolver than the hydrofluoric acid that dissolves the zirconium!

Measurements

As with any chemical process, analysis is extremely important for process control. This is only a third of it at a nuclear processing plant where accountability and criticality control are as important as process control.

In an ordinary chemical plant, the analyst is concerned with a particular element or elements, but in the nuclear plant the problem is complicated by the presence of isotopes of the element you are looking for and fission products.

Dissolver samples are extremely complex, especially for the determination of uranium. Uranium concentrations are low, from 1 to 20 grams/liter, compared to the alloying constituent and complexing agents that may have been added. Fission products that may be present undergo reactions similar to uranium in conventional analytical methods for its determination. Add to these problems the fact that the sample must be drawn and analyzed by remote means and you can see that this is not quite like an ordinary chemical plant.

Measurements is a complete subject in itself, there is not space here to go into the methods and means employed at the ICPP in detail. The work requires a standard of accuracy far above ordinary analysis, but to the highly trained personnel at ICPP, it is almost routine.

ICPP Direct Maintained

Because much equipment, such as that required for dissolving and first cycle extraction, rapidly becomes very highly contaminated

with radioactive materials, the problem of equipment maintenance and repair requires special consideration. At the ICPP, remote maintenance means have not been provided; therefore, it is necessary to decontaminate defective equipment for maintenance, repairs or modifications.

Process equipment is designed with sufficient capacity to permit periodic shutdown for maintenance. There are spares for essential units. Equipment is of simple mechanical design for easy decontamination and repair and contains a minimum of moving parts. Where practical, equipment is segregated by activity level. Process cells are lined with stainless steel to permit complete decontamination.

The feasibility of this approach has been proved in that all process cells have been decontaminated enough for personnel entry from one to several times. Further, design for direct maintenance permits a maximum of process equipment to be placed in each cell since no provision need be made for removal by remote methods. This type of design has resulted in substantial construction cost savings as compared to remote maintenance plants.

ACKNOWLEDGEMENTS

This article, the third in a series of five, is based on four papers presented by members of the ICPP staff at the AEC's symposium on Chemical Processing of Irradiated Fuels from Power, Test and Research Reactors held at Richland, Wash., Oct. 20-21, 1959.

The next article in this series will appear in the Feb. 22, 1960, issue of *Chemical Engineering*.

The papers are: "ICPP Plans for Processing Irradiated Fuels from Research, Test and Power Reactors" by C. E. Stevenson; "ICPP Facilities for Receiving, Storage and Mechanical Treatment" by A. L. Ayers and C. B. Leek, "ICPP Input Measurement Program" by F. H. Tingey; and "ICPP Dissolution, Extraction and Waste Treatment Processes and Facilities" by F. M. Warzel.

The complete proceedings of the symposium are available from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C. Ask for Bulletin No. TID 7583.

When you purchase process equipment . . .

How Do You Evaluate the Proposal?

A vendor summarizes his case:

- What objective factors can you weigh?
- Why does subjective evaluation enter?
- When is a roundtable with vendors necessary?
- What should you know about "guarantees?"

Buyers of equipment add comments.

NORMAN H. PARKER, Tower Iron Works, Inc., Providence, R. I.

PROPOSAL evaluation can be divided into three steps, each of which is a separate entity in itself. We have emphasized the vendors' interest in reviewing their proposals to the complete satisfaction of the prospective purchaser. This could actually be considered step one of the evaluation process: roundtable discussions with each vendor on his proposal.

From a purchaser's viewpoint, the facts presented and developed during these discussions can be divided into two parts—those which can be classified as objective or tangible factors, and those which are subjective or intangibles.

What are the tangible factors? In order of importance, they are

1. Functional design, directly concerned with process operation.
2. Special mechanical features which contribute to efficient, maintenance-free operation.
3. First cost.
4. Installed cost.
5. Maintenance costs.

It is easy to see why functional design is of first importance. The successful operation of any process step depends upon the proper func-

tional design of the equipment in that step. For example, it would certainly be in order to question the functional design submitted by a vendor of a dryer, let us say, which was 15 to 20% under the sizes submitted by other vendors, provided that it was done without divulging competitors' data.

Similarly, in the case of mixers, a major difference in installed horsepower or impeller size would suggest further conferences to discuss the functional design aspect of the problem. In each case, at this stage of evaluation, the designs should be compared solely on a functional basis. No reputable vendor will ever refuse to discuss the functional design bases of his proposal.

Second only to the functional design in importance is the mechanical design. Each vendor spends many dollars worth of engineering time on mechanical features which he feels will contribute to the more effective and efficient operation of his equipment, and make it as maintenance-free as possible. In rotating equipment, such parts as gears, bearings, materials of construction of trunnion rolls or impellers, and shaft sizes may determine service life of the equipment and should be discussed as part of this phase of evaluation.

However, care should be exercised in the determination of which

mechanical features contribute to the efficient operation of the equipment, and which do not. No example could be described as typical because each should be examined in light of its application, but one might question such a "rube gold-berg" as a motored reducer used to drive a rotary dryer which also provided the transfer medium to heat the incoming air. In other words, be on the alert for "ginger-bread" or "gimmicks" which may be attention-getters but do not serve a specific need, or contribute to more efficient mechanical or functional operation. When you turn over responsibility to someone else, you should not give up good judgment.

CONSULTANT says . . .

"Besides being reluctant to make designs obsolete, each vendor adopts improvements based only on his own research, undertaken to improve his own market position. Design improvements suggested by an independent engineer cut across this line, incorporate what's best for the client. With this design, vendors compete on basis of manufacturing efficiency. Too, the client of an independent engineer can use proprietary products when they are best suited to his needs; his engineer specifies according to

Part 3 in a series of 3

See page 114 for capsule contents of the whole series.

needs. Development costs are not borne by those who don't benefit by them."

After the functional and mechanical design have been thoroughly evaluated, the first cost relationship will round out the picture. At this point, it will be necessary to be sure that all bids are on a comparable basis, so far as auxiliaries and extras are concerned. When this is done, a direct relationship can be established between first cost and equipment quality and performance expectation. The quality will have been established—quality of design, materials and workmanship—in the mechanical review and performance expectation in the functional design review.

At this point you may be saying, "There is some contradiction here. The author said before that the vendors preferred to present as little data in written form or as specifications as possible. How can we make this sort of evaluation without something more than verbal discussions to extract the evaluation data from?"

I would like to repeat again my basic premise. If the prospective purchaser of process equipment will make the "responsibility decision" and stick to it, most of the reasons for not presenting complete specifications and data will be eliminated. Most vendors will extend to a prospective purchaser that degree of cooperation he may desire with-

out reservation until that individual or company no longer merits it, even to presenting complete specifications and functional and mechanical design data.

CHEMICAL COMPANY says . . .

"The larger, more reputable firms will lean over backward to avoid being obligated to a vendor by having obtained expensive engineering assistance at no charge. For example, our firm often prefers to pay outright for any detailed design work that is done, so that we feel morally free at the end of the work to do anything we please with it."

The installed cost should not present any special problems. It is possible that some of the special mechanical design features may simplify or reduce the cost of installation.

Maintenance costs are directly related to mechanical design features, and may be estimated in relation to them. Here again, thorough evaluation of mechanical design previously performed may indicate that maintenance has been simplified or made more difficult by any special features which have been included.

Much harder to evaluate are the intangibles because they are subjective. They may be classified as follows

1. Vendor experience with process or product.
2. Vendor reputation for responsibility.
3. Guarantee—fact or fiction.
4. Prior experience with vendor.
5. Your confidence in the vendor.

Evaluation of vendor experience with a process or product goes much deeper, of course, than simply asking about prior experience. Lack of experience *per se* should not necessarily imply a lack of ability to perform successfully. On the other hand, prior experience does not provide automatic qualification to perform successfully.

All of us have had jobs which have not performed spectacularly at startup. On the other hand many of us have brought seemingly unrelated experience into a situation which has enabled us to solve new problems. So it is with evaluation of vendor experience.

A vendor who brings to a problem unrelated experience may be equally qualified as one whose experience is in the solution of that problem alone. Although the weight of experience is on the side of one, the new viewpoint—backed by sound, broad experience in the field of specialization—should receive equal consideration, with the other factors taken into consideration which were mentioned before.

Vendor reputation for responsibility is another important factor which should be weighed carefully. Of course, we can make the generalization that no company could remain in business today that did not stand behind its products. However, in every field of endeavor there are persons or companies who seek to evade as much responsibility for performance as possible. In this particular respect, clear definition of responsibilities in the initial stages of bid request can eliminate the unreliaables. But, in the final analysis, vendor reputation should count heavily.

In the last few years there has been a tendency in the process industries to use the word "guarantee" as a crutch. In this case, this is not to be confused with a warranty on material or parts. We refer specifically to the "guarantee" used in connection with process equipment. Analyzed, most so-called guarantees agree to remove and replace the equipment if that originally furnished is deemed unsatisfactory, with qualifications.

Exactly what does this mean to you in terms of keeping your plant running? Take the imaginary case of a dryer which fails to come up to performance expectations. Would you consent to having a whole process down while the manufacturer removes the dryer and replaces it with a different one? Would you ask the vendor to stand behind his "guarantee," or would you ask him to send someone to your plant to bring the equipment up to performance requirements? The latter, of course.

So, in effect, the "guarantee" means nothing. To some purchaser, however, it may provide a crutch whereby some of the responsibility for the correctness of the selection decision can be evaded or shifted by means of the phrase, "if it doesn't work, well, it's guaranteed." But should this be so?

What of the vendor who says, "I



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From ship to train or shoreside storage . . .

TWO MILLION POUNDS OF BULK MATERIAL handled daily by 8 Michigan Tractor Shovels

On Philadelphia's waterfront, eight high-speed tractor shovels are moving the amazing total of two million pounds of bulk material every 8 hour shift!

The machines are 16 cubic foot Model 12B Michigans. Their job, for Independent Pier Co., is to transfer England-imported china clay from temporary shipside hoppers to waiting rail cars and storage bins. Despite the high-volume output, it's not an easy assignment. Material, when disturbed, rises in choking clouds of dust, quickly covering men and machines. Loads must be moved through traffic 60 to 900 feet. And all work has to be done quickly to minimize high dock charges.

Under these pressures, Independent Pier has developed probably the fastest operation of its type along the waterfront—built around the speed and mobility of the eight Michigans.

Load-unload cycle averages 58 seconds

Approaching the hopper head-on, bucket skimming the dock, a Michigan in typical operation thrusts into the heaped clay. With flick of tilt-action lever, operator brings up his pay-load. No time is lost in repeated bucking; Michigan's pry-out action heaps bucket in a few seconds. At same instant, a flip of the forward-reverse lever backs the Michigan out of the hopper in a fast, tight

turn. In "forward" again, the Michigan races for a boxcar, barely slowing to turn in—even through narrow six-foot doors. To heap



the clay as high as possible in either end of the car, the Michigan charges up the slope as if it were a hill. At top, operator simultaneously dumps bucket and power-shifts into reverse; the Model 12B backs down and swings out the door, ready to repeat the cycle. Operating at top speed through thick dust fog, over round trip haul cycles of 120 to 1800 feet, the Michigans have established a load-unload average of only 58 seconds!

Maintenance, new operators no problem

"Maintenance-wise" says master mechanic Mike Snowden Jr, "there's no comparison between these Michigans and other equip-

ment. They not only need a lot less attention, they're much easier to service. A quick check at lunchtime—mainly knocking dust out of air filters—keeps them in top shape. Ruggedness and ease of operation are advantages, too. Hiring new stevedores every day means new operators for the Michigans—and *could* cause trouble. But new men learn fast on those simplified controls. They don't have to fight a clutch, either, and power steering is a big help pushing around in that clay."

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stand behind my equipment unequivocally." Is not he in essence more honest—more ethical, if you will—than one who hides behind a "guarantee?" Certainly no more weight in the final decision should be given the vendor who "guarantees" his product than one who says "I stand fully behind every piece of equipment I sell."

OIL COMPANY says . . .

"The discussion of the problem of vendors' 'guarantee' points out an important factor that is often overlooked in equipment purchase. Confidence in the vendor should be a major point in equipment selection; the manufacturer's warranty doesn't cover losses from interruption in plant operation."

The last two intangibles can be interrelated—confidence in and prior experience with a vendor. But confidence alone may be a factor if prior experience is lacking. By itself, it may be the one most important factor, because all other things being equal all of us will turn to those in whom we have confidence first. In one sense, we might say that the purpose of a "guarantee" policy is to instill confidence. But whatever its source may be—either from past experience or from growth during the discussions and evaluation—confidence will be an important factor in arriving at a final decision.

After the tangible and intangible factors have been evaluated and weighed, one or more bidders will probably have been eliminated, leaving at most three, at least one. If there can be no doubt as to the final choice of vendor, then you are ready to place an order. However, if more than one bidder remains under consideration, then it would be advisable to have one final review with each prospective vendor.

At this time, it is preferable to review with each vendor not only any points in the evaluation which were in question, but also any revisions in process data which have occurred or been made. This will enable the remaining bidders to bring their proposals up to date process-wise, if that is required. This final review should not, however, be allowed to degenerate into a bargaining session, nor should

this be the intent. Upon completion of this final review with the remaining vendors, you should be ready to place an order.

The following steps review in outline the course recommended by the author—from recognition of the need to the final decision to purchase.

1. Recognition of the need.
2. The "responsibility decision"—the basis of purchase: engineer the job ourselves and use a specialty fabricator; or, do the functional engineering only and use a specialty fabricator whose responsibility will be only for mechanical design; or, turn the entire job over to a major equipment vendor who will be responsible for functional and mechanical engineering. As we have pointed out throughout this series, and as we point out again now—it cannot be emphasized too strongly, the responsibility decision is the key to good relations.

CONSULTANT says . . .

"An engineer retained to assist in a procurement problem may be employed for the entire project from inception to supervision of construction. Or his work may encompass only preliminary work. It is seldom wise, however, for him to make such things as shop details. The experienced engineer in any field knows where the designer's work

ends and the shop's work begins. This discrimination is necessary because much of the economy available in competitive bidding results from variations in efficiency of shops all working from the same design plans."

3. Specifications for the vendor: definition of responsibility and specification of design criteria based on one of the three alternatives of the "responsibility decision;" establishing whether request is for a budget or firm estimate.

4. Evaluation: roundtable discussion with each prospective vendor to discuss design bases, with the obligation not to divulge or trade data among the vendors; intra-company review of the tangible and intangible factors (*tangible*—functional design, mechanical features, first cost, installed cost, maintenance cost; *intangible*—vendor experience, vendor reputation, prior experience with vendor, confidence); final review with remaining prospective vendors to clear up any points in question, not to bargain.

The foregoing discussion, taken with the previous installments in the series that appeared in *Chemical Engineering*, Dec. 14 and Dec. 28, 1959, is an attempt to provide the vendor's viewpoint for maintaining order and reason to the buyer-seller relation. We welcome your views!

Practical Buyer-Seller Ethics

In this three-part series of articles, Mr. Parker has considered the following points:

- 1 How to determine responsibility. What you should know about equipment. How the vendor should be brought into the job. (*CE*, Dec. 14, p. 61.)
- 2 What the vendor expects of you in a wholesome ethical relation. (*CE*, Dec. 28, p. 81.)
- 3 Evaluating bid proposals. Weighing tangibles and intangibles. Making the final decision. (This issue.)

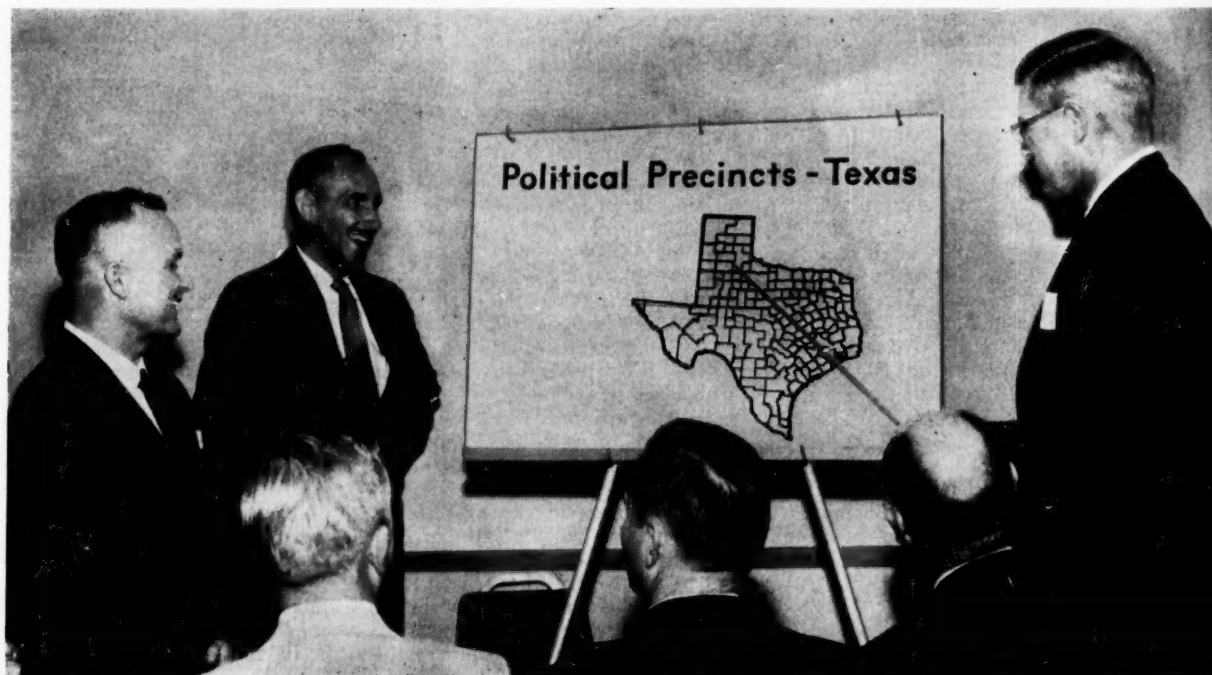
Let us hear from you

As a buyer or seller of equipment, you may have experience that verifies or contradicts the opinions of Mr. Parker or our commentators. What can you add to the discussion that will clarify some of the hazy areas such as responsibility, ethics and other nebulous considerations? Send your opinions—confirm, argue or amplify, as you will—to the Editor, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.

PRACTICE...

YOU & YOUR JOB

EDITED BY R. F. FREMED



"If you can't lick them, join them and infiltrate," is the advice offered by Union Carbide's Tom A. Wilker.

Engineers Enter the Political Arena

Texas symposium spotlights the role of the engineer as his employer gets into the political act.

Chicago conference spells out the ground rules.

For more than a year now we've been pushing aside various suggestions that we ought to devote space in these columns to management's increased emphasis on political awareness.

We had considered this to be a "general management" subject which would be of very little in-

terest to engineers in management positions; and of absolutely no interest to most other engineers.

Now, some chemical engineers from Texas have come along and shown us that we were either wrong or misinformed. Engineers have an important role to

play in politics; and in the years ahead more and more of you will be expected by your employers to take an active part in political battles.

► **Texas Means Big**—As you may remember, Texas used to be the largest state in the Union. (Alaska has changed all of that

now.) But Texas can still boast about being the largest something.

Each year the South Texas Section of the American Institute of Chemical Engineers sponsors an all-day technical meeting on the shores of the Gulf of Mexico in Galveston. Whereas in other sections of the Nation, a one-day technical meeting is considered to be a success when several hundred attendees have been counted, South Texas will settle for nothing less than a thousand registrants.

In fact, at the most recent session in Galveston, more than 1,100 chemical engineers registered.

One of the panels was devoted to the subject of "Management in Politics." Attendance was limited to the first 50 who signed up and the session was an early "sell-out."

► **Unusual Departure**—Moderator of the session was Plant Superintendent Tom A. Wilker of Union Carbide Chemicals Co. He's the engineer—member of AIChE—who has complete

charge of Carbide's 2,500-man Texas City operation. (And to conform with the law covering contacts with the state legislature, Tom Wilker is also a registered lobbyist in Austin.)

Advised in advance that the session would be an unusual departure from previous "no comment" positions, *CE's* Southwestern Editor, Thomas H. Arnold, Jr., stationed himself as part of the select audience. Through the assistance of Union Carbide, *CE* now has an exclusive transcript of the tape-recorded discussions.

Here are the highlights.

► **An Overworked Subject**—Tom Wilker introduced the subject noting that the idea of management in politics is new, relatively speaking, but in a short time it has been worked overtime by every available communications medium. You have been alerted to this new trend by newspapers, trade magazines, TV, etc.

Wilker explained why he is interested in politics. His reasoning: "Think of the time you or your management spend on company subsidiaries or problems in which you have a 50% interest, or even less. Then compare the almost complete indifference in considering the problems presented by a major partner—the government—52% of gross for taxes.

"At 52% we decided we won't sleep peacefully until we learn how to deal with the senior partner. This is the broad picture. You might say 52% corporate income tax is someone else's worry.

"Well, let's get personal. Your paycheck comes to you after taxes, and examining the fine print, what's the biggest deduction from your paycheck for? It's for taxes. So you and your management are in politics after all."

Therefore, Wilker decided to really make an effort to get to know some politicians. This is what he learned, "Acquaintance proved that politics does not have to be a dirty game. If it is that way, we have contributed to the delinquency by our own neglect."

► **If You Can't Lick 'Em**—Here's Wilker's firm conclusion on the subject of engineers in

politics: "You'll either have to be an interested capitalist or a socialist by default.

"Believe it or not, we decided to go along with the Roosevelt new-deal-era economist, Raymond Moley. Let me quote, 'The battleground is where lawmakers not laws are made. Politics is not something to avoid or abolish or destroy. It is a condition like the atmosphere we breathe. It is something to live with, to influence if we wish and to control if we can. We must master its ways, or we shall be controlled by those who do.'

"In other words, if you can't lick them, join them and infiltrate."

► **Audience Feedback**—Next panelist was George Thompson, head of training and personnel, research and development division, of Union Carbide Chemicals in Texas City.

Thompson invited the audience to share their experience in the field of politics, "Those of you who come from companies that are interested in this question of politics, would you tell us briefly what your company is doing in this area of telling you or other employees about what it takes to be influential in politics?"

Here are some of the audience replies:

Monsanto—At Texas City we are giving a small group of supervisors this course by the Chamber of Commerce called "Action Course in Practical Politics." We are through six sessions now and it's quite a good course. It teaches you the mechanism of politics and where to start if you decide to do something. It's nonpartisan.

Diamond Alkali—What's going on here is the same way it started off in Diamond Alkali. We talk to engineers and people like that. We've sent people to the Texas Manufacturers' Assn. conference where they teach people how to be active in politics. At lunchtime fellows in our personnel department, usually the personnel manager, give us run-downs on bills that are scheduled to come up in the state legislature. But you're not supposed to write to your legislator or senator on company stationery.

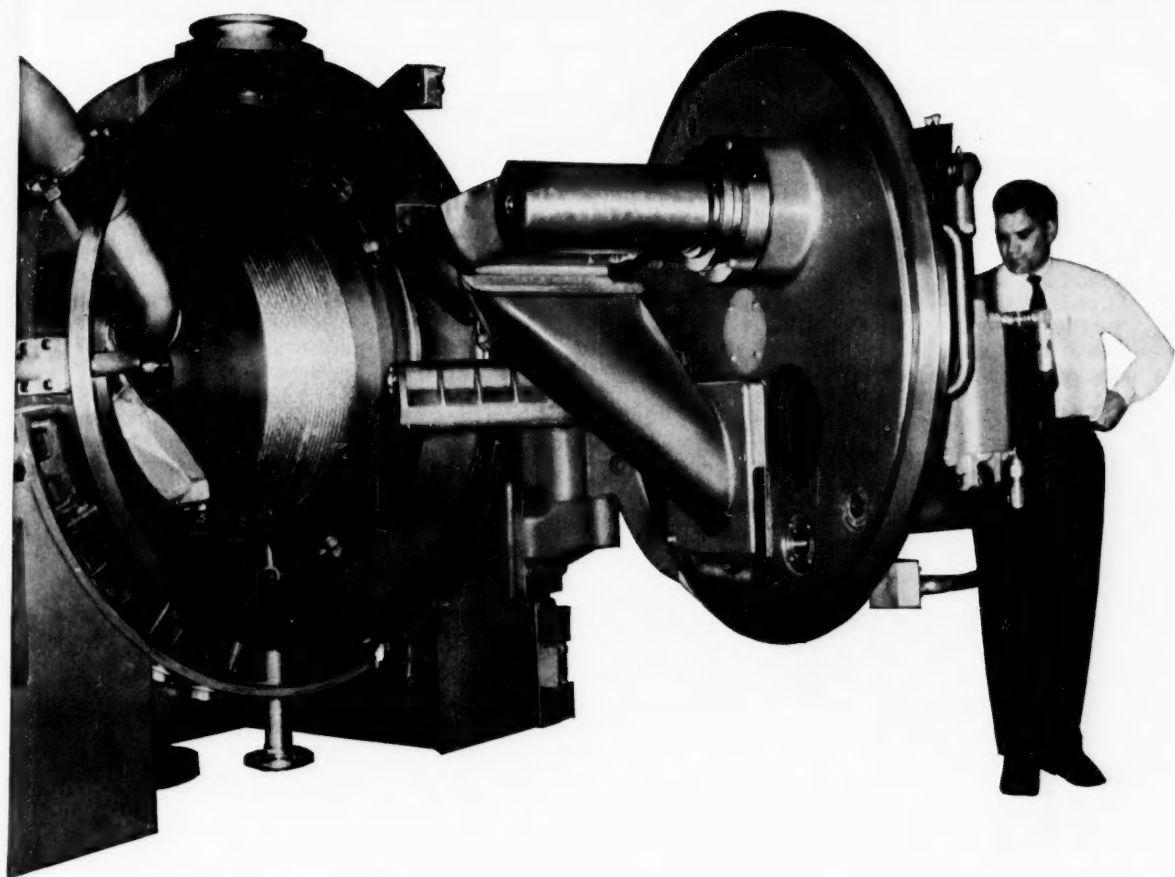
B. F. Goodrich—We've sent out all sorts of literature, politi-

What Are Your Answers?

George L. Clayton, Director of Public Affairs, Union Carbide Chemicals Co., Texas City, Tex., suggests that you judge your own political awareness by scoring your answers to this simple list of questions.

1. Who is your representative in the Congress of the United States?
2. Who are your U. S. Senators?
3. What is their voting record?
4. Who are your representatives to the legislative bodies in your state capital?
5. What is their voting record?
6. How many times have you written to them? Called them? Wired them?
7. Who are your city commissioners or councilmen?
8. Who are your county commissioners?
9. Who are your school board members?
10. What are their voting records?
11. Have you ever taken part in any political action program in the party of your choice? Have you ever been to a local precinct meeting?
12. Have you paid your state poll tax? Have you registered to vote?

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cal, economic and on company policies. House organs are used for this in a slight way.

Rohm & Haas—We have what we call "middle management" sessions for production engineers and technical service engineers. We touched on politics briefly and then dropped it because we didn't want to be misinterpreted by our hourly employees.

Union Carbide—We believe that the key to the whole thing is to inform ourselves first and to build our knowledge in the field

of political action. We've been at it for at least three years now.

Shell Oil—I've been sitting here thinking. It seems to me that in the final analysis we have to get it down into terms which allow each individual engineer to decide that it means something to him personally.

► **What It Means to You**—Very appropriately, the third panelist, George Clayton then suggested that each engineer test himself on his own political awareness.

If you'd like to try the test, you'll find it on p. 116.

directly the things we would like done directly."

A company assigning an employee to work in politics was described as being in the "gray area" depending on the length of time involved, how close it fell to his normal duties, whether the employee was an hourly worker or an executive. Consensus was that there is probably more freedom along this line for white-collars than blue-collars. But no harm would be done by allowing a worker to take a day off for duties such as poll-watching.

In response to a question one panelist said that he would not recommend starting test cases to determine what constituted a contribution by a company in the political field. He said, rather, it would be best to "do what we know we can do."

Asked by the chairman to suggest some of the most effective ways for business to participate in the political process, the panelists suggested:

- Urging employees to register and vote.
- Asking employees to become familiar with the issues that affect their companies.
- Take part in local elections.
- Encourage all of these things through objective political education groups.

The afternoon session on whether a company should enter the political arena brought even more diverse reactions. One panelist took the stand that by and large the American public does not approve of corporations taking a direct role in politics.

It was agreed that business leaders should speak up on certain political matters, but in a "temperate and reasonable" fashion. The need for continuity in a corporate political program was stressed; and the thought was expressed that middle management people may be shying away from taking part in politics for fear of not being on the same side as top management, and therefore jeopardizing their advancement possibilities.

And the final panelist admonished the assembled group with this phrase "I think you're determined to go into politics—don't get sour when you find your expectations have not been fulfilled."

If Your Company Gets Into Politics

Conference in Chicago presents expert, legal and practical advice to employers who want to participate in politics.

Stewart Ramsey, Chief, McGraw-Hill Midwest News Bureau

Corporations that want to get into some form of political activity can probably do so to their best advantage by urging employees to register and vote; learn the machinery of their political system; and to study the issues.

But there remains a very large "gray area" where more partisan activity by a company could run afoul of various restrictive laws. And it's probably best not to try to test such statutes on constitutional grounds.

These were some of the broad general conclusions drawn from a day-long session held in Chicago recently under the sponsorship of the National Industrial Conference Board. The discussions, centered around the questions of whether a company should participate in the political process, and if so, what would be the best way, sparked heated debate from the dozen panelists.

Volleys of questions fired from the audience indicated the high interest in the no-holds-barred sessions.

A morning conference explored the legal limitations of corporate activity in the political field. Three attorneys were impaneled to describe three main sources of legal restraints: the Federal Corrupt Practices Act,

state corrupt practices acts and the Hatch Act.

For example, in cases where federal and state elections are involved simultaneously, it is all right for companies to set up nonpartisan political education groups for employees. But it would be unwise to organize "voluntary" contribution plans.

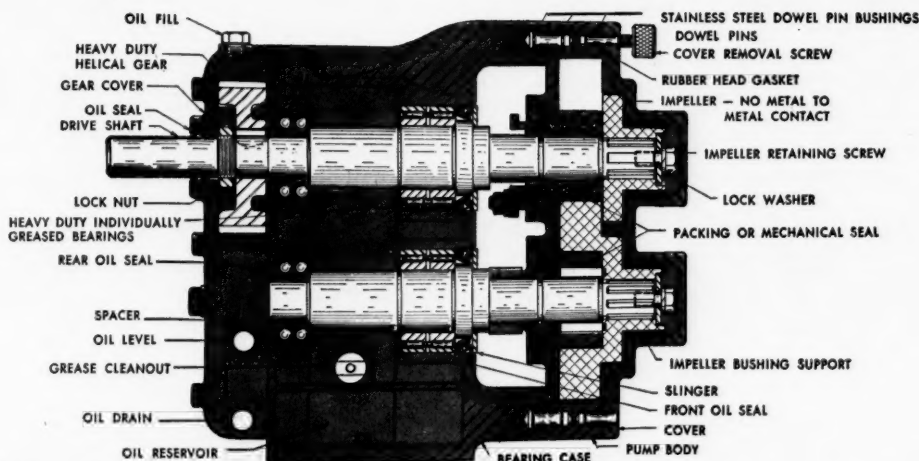
Some 37 states now have corrupt practices acts, some in a very limited form. Some are very comprehensive. If an employee is assigned to work for a state or local candidate, that might be legal in 21 states. It would be in a "gray area" in other states; was possibly illegal in 15 states.

Still another danger to corporate activity lurks in certain state statutes not aimed specifically at curbing such activity, but containing provisions restraining it for certain businesses, such as those under state regulation.

Skepticism was expressed about a company's ability to remain objective in setting up a political education group for employees. Perhaps an outside, nonprofit organization would be better for handling such an activity.

It was suggested, also, that "it would be better to accomplish in-

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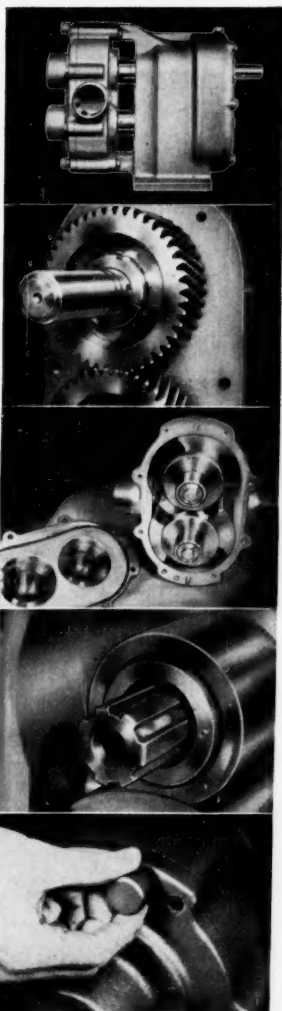
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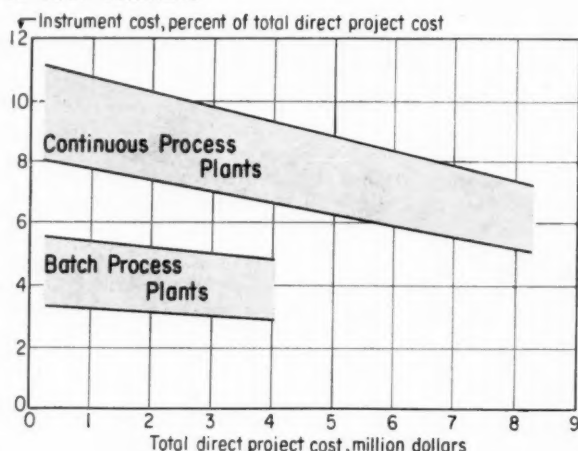
Process control instrumentation successfully eludes evaluation on cost vs. capacity basis. In Cost File 22, Jan. 11, we tabulated typical purchased cost of industrial instruments. However, other ways have been suggested for estimating capital requirements for instrumentation.

Commonly, instrument costs are factored as a percentage of total purchased equipment costs. Factors are dependent on "sophistication" of proposed instrumentation. (See, for

example, Aries & Newton, "Chemical Engineering Cost Estimation," McGraw-Hill, 1955, p. 97, and Vilbrandt & Dryden, "Chemical Engineering Plant Design," McGraw-Hill, 1958, pp. 194, 209.)

Material in this Cost File is reprinted from *Control Engineering*, Feb. 1958, p. 88. In addition to these two order-of-magnitude techniques, the original article shows a detailed estimate for a distillation control based on installed cost of individual instruments.

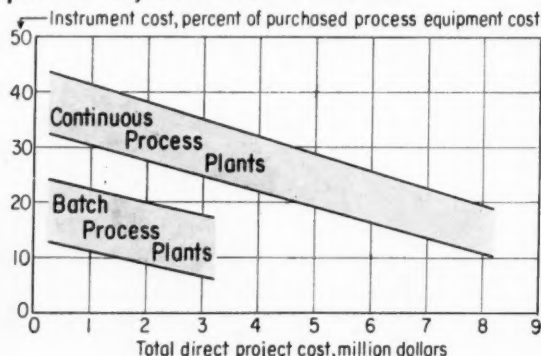
For first estimate



Do You Have Something to Contribute?

If you have correlated cost data—either graphical or tabular—for order-of-magnitude estimating in the process industries, send it to Cost File Editor, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y. We pay regular space rates for all that is used.

For preliminary economic evaluation*



*Data obtained from Dow Chemical survey of production-size process plant—open-type construction with minimum amount of buildings. Do not include engineering fees and overhead which amount to about 25-30% of total direct cost.

Reprints

The series of Cost Files from No. 1 through No. 21 are now available in one reprint. To get your copy (cost: 50¢), check number 153 on the Reader Service card.

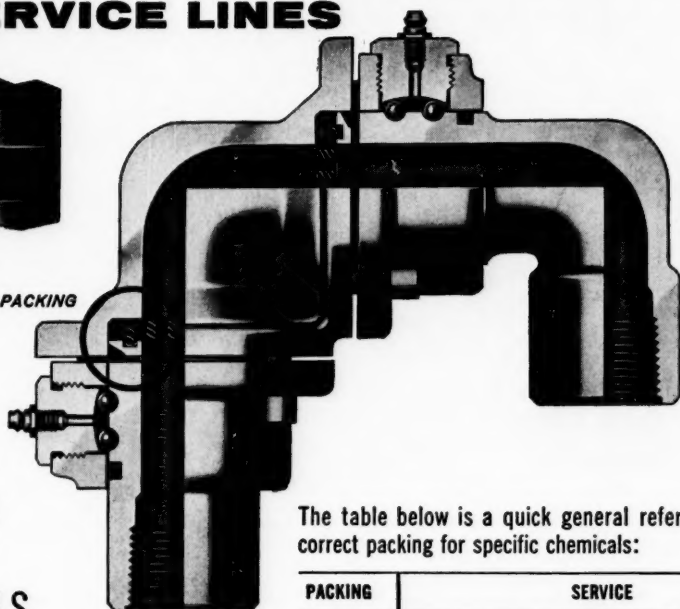
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The table below is a quick general reference for the correct packing for specific chemicals:

PACKING	SERVICE
Neoprene	Recommended for alkaline and acid salt solutions and aldehydes such as formaldehyde.
Hycar	These should be used for petroleum derivatives, neutral or slightly acidic salt solutions, dilute acids (Sulfuric to 50%, Hydrochloric and Nitric to 20%), alcohols, glycols, ethers, gases (Oxygen not over 500 psi), and vegetable oils.
Butyl	Recommended for liquid or anhydrous ammonia, gases (except oxygen over 500 psi), ammonia derivatives such as hydrazine and for certain hydraulic fluids such as Pydraul, Skydrol, and Cellulube. It is recommended for acetone and methyl ethyl ketone.
Teflon*	Used for concentrated or fuming acids and other highly oxidizing fluids, esters, aromatics, liquid chlorine, bromine and fluorine if temperature is not excessive.
Asbestos	For use in saturated steam service.
Viton "A"	Recommended for use with concentrated acids, aromatics, liquid chlorine, liquid bromine, chlorine or bromine derivatives, molten sulfur, and carbon disulfide.
Metallic	For extreme services such as hot gas at 600°F., a Stainless Steel metal disc, specially treated to prevent galling, is recommended.

* R.T.M. DU PONT

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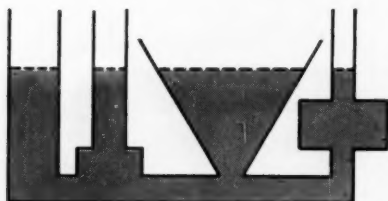
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The well-known fact that liquid "seeks its own level" provides an easy method of dividing a batch into two or more equal or unequal parts.

For Batching Use Hydraulic Paradox

A. W. Billitzer

Beckers Pty. Ltd., Research Laboratories, Dudley Park, South Australia.

Physics text books commonly use a drawing similar to that above to illustrate, under the heading of "Hydraulic Paradox," the fact that liquid will stand at the same height in a group of connected vessels, regardless of shape. This well-known phenomenon can be used in the plant for simple automatic measuring in cases where a more elaborate installation might be impossible because of space or expense.

The simplest case, involving the halving of a given volume, was used to solve a problem in our plant and is illustrated in Figs. 1 and 2.

Certain processing changes required the successive charging of equal volumes of solvent and recrystallization liquors to each of three reactors. In the existing setup (Fig. 1), each reactor had a measuring-charging tank with a capacity equal to the reactor charge. These were mounted at the same level on a platform where there was insufficient space for extra tanks.

We repiped as in Fig. 2, with the additional valves shown. Since the tanks were of the same diameter, the new setup made it possible to halve each charge of solvent and liquors accurately, using any pair of tanks, then charge in that order to any of the reactors as they became ready. Note dotted lines, Fig. 2.

The original setup included three reactors and three measuring-charging tanks, all connected as shown.

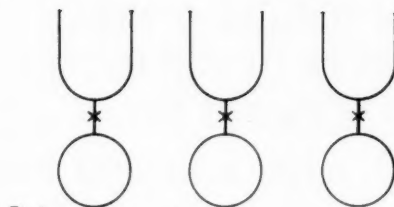


Fig. 1

By adding pipe and valves, it became possible to halve each charge of solvent and liquors, to charge any pair of tanks.

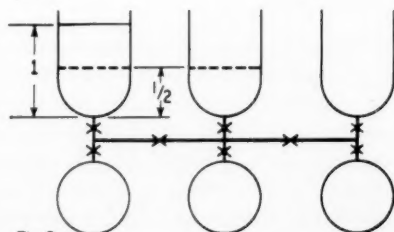


Fig. 2

The same idea can be used for subdividing a charge in other ways such as quarters; or to subdivide one division.

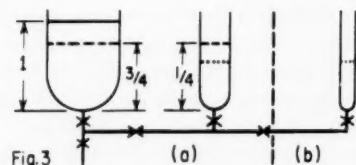


Fig. 3

This idea is so flexible that it can be applied to subdividing a given volume automatically in almost any way desired. Suppose, for example, that we want to add three-quarters of a charge of liquid initially, followed by the last quarter at a later time. The setup in Fig. 3a will divide the whole charge in

this ratio if the second vessel is chosen to have one-quarter of the volume of the whole charge after the liquid is levelled. Then suppose we want to subdivide a part of the initial volume. The additional vessel at 3b can be added to subdivide further the quarter of the original charge shown in 3a.

CORROSION RESISTANT

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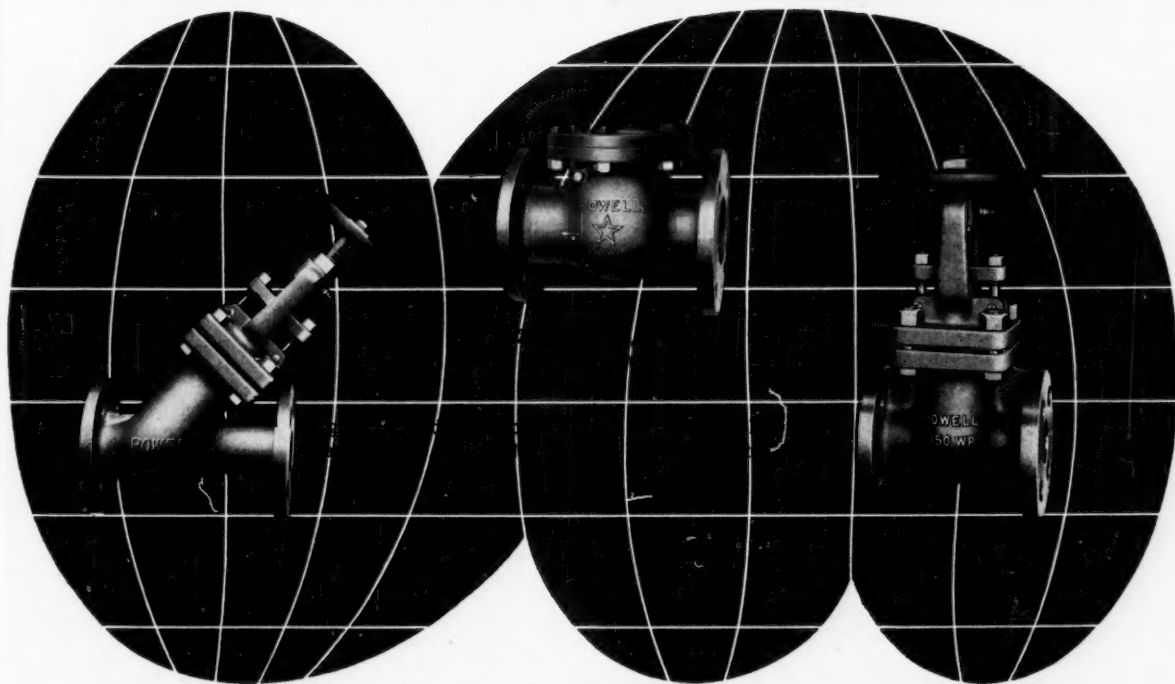
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Cut Maintenance Costs By Cylinder Care

Paul C. Ziemke

Engineer, Clinton, Tenn.

Although they are built to take heavy usage and contain very high pressures, compressed gas cylinders must be handled with care. They should never be thrown about, stacked like cordwood, nor stored where they will be exposed to high heat, corrosive fumes or continuous high humidity. Overheating is presumed to have been the cause of what happened to the oxygen cylinder pictured above. But, more of this later.

In moving cylinders around they shouldn't be rolled, dragged or lugged. For casual movement of a few cylinders they can be "spun" on the bottom flange—an expert even spinning two at a time. For lifting, don't depend on slings, chains or electromagnets and particularly avoid lifting by threading a line through the holes of the protective cap. Hoisting is best done with an angle-iron-framed platform. A cart can handle small consignments. For truck shipments use a truck equipped with stanchions and chains to prevent tipping or sliding.

Cylinders can develop dangerously high pressures if stored in the direct sunlight or near high-temperature sources. But they should also be protected from excessive cooling owing to the embrittlement of steel at low temperatures.

When oxygen and acetylene

cylinders are stored in a welding area where arc welding is under way it is possible for them to become part of the current path inadvertently and cause arc burns. This form of damage is difficult to detect visually and usually can be discovered only when the cylinder receives its five-yearly pressure test. To avoid this possibility, keep cylinders away from the welding fixtures and work table or put them on a wood base to serve as an insulator.

It is important, whenever the cylinder is in storage or is being moved, that the valve be protected by having the safety cap screwed in place. In storage, protect the cylinder against moisture, corrosion and excessive heat or cold. If the valve should leak, or if it should freeze and refuse to open with a reasonable amount of force, it is best to notify the vendor.

Proper identification of the cylinder contents is important. Painting on the name and formula of the gas is effective if the label will not be defaced by normal use. Color bands are inadequate since some people are color blind, while mercury vapor lighting changes color values. A durable fiber tag attached to the valve stem is very effective. It can be used to indicate that the cylinder is exhausted and it can be renewed whenever the cylinder is refilled.

In hooking up a cylinder it is

important to use the right pressure regulator. Different kinds of threaded connections and unions are used to prevent improper interchanges. Many accidents have occurred when plant shops have tried to circumvent this safeguard by turning out adapters to permit use of non-conforming equipment.

The oxygen cylinder shown above is a striking example of how improper cylinder treatment may react at some later date. At the time of the damage, the cylinder was in a temperature-controlled area where heat could not have damaged the fusible lead plug. Presumably the cylinder had been overheated at some earlier date, softening the lead plug slightly and allowing the rupture disk to bulge out a bit, but without a leak. Then later, for some reason that isn't clear, the plug sprang a leak and jetted 3,000-psi. oxygen downward on the rusty threads of the cap.

It is probable that the rust was contaminated with the fatty residues from many years of soap-suds application to detect leaks. When the oxygen hit this combination it became incandescent. The internal pressure burst the cylinder with explosive force and with the sound of two heavy-gauge shot-gun shells fired simultaneously. Surprisingly, the bronze valve was virtually untouched while the iron valve handwheel, cap and cylinder were all extensively damaged.

Next Issue: Using Thermistors for Interface Control

By Frederick Fahnoe, Winner of the December Contest

★ How Readers Can Win

\$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebooks.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates (\$10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

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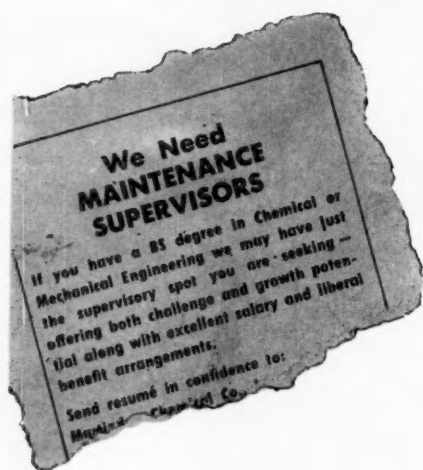
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CHEMICAL ENGINEERING—January 25, 1960



Ch. E.'s Find More Room In Maintenance

. . . New Developments Boost Engineer's Role

"Challenge and growth along with excellent salary." Sounds like an interesting position, doesn't it? That's just the type of job offered to chemical engineers who can take on the responsibilities of maintenance supervision.

► **New Demands**—The process industries are in the front wave of a great change sweeping over industry. Demands are being placed on engineers to meet the problems of highly controlled and automated operations. This means acquiring new skills, learning new techniques, forgetting old ideas and even entering new fields.

Nowhere is this more evident than in the actual day-to-day running of the plant. Concept and scope of just what makes up plant operations is undergoing a change that in some circles might be called revolutionary.

Where maintenance, at one time, was the unwanted stepchild, the necessary evil relegated to the dirty job of "fixing and repairing," it now must be considered an integral part of the actual operating job.

The evolution of the past ten years has been somewhat dramatic in that engineers are devoting far more of their time to managing the maintenance function and administering maintenance management tools. In the past they were somewhat

subservient to production people and devoted most of their time doing what other people wanted, when they wanted it done.

But, hard-to-move, traditional ideas are changing. It's simple: we can no longer afford excessive and unplanned downtime. Risks involved in plant operations must be reduced.

► **Make Sure It Runs Tomorrow**—The primary job, in plain words, is more than just running a plant. It also includes the assurance that the plant is running tomorrow and the day after that.

It's the growing challenge to management to look again and again at maintenance and come up with the answer to this problem. Throughout the chemical industry this change in approach to maintenance is going on.

In St. Louis at Monsanto's Organic Chemicals Div., W. E. Chandler, Manager of Maintenance Engineering Services, states the case for a new approach: "We now look on maintenance as a primary plant function and are organized so management responsibility is placed on the maintenance managers. This is a result of the transition over the past 10 to 15 years from the point where maintenance was looked at as a necessary evil, a subservient and secondary function."

► **Future Plant Managers?**

This changing pattern was stated succinctly in a recent report (*Chem. Wk.*, Mar. 15, 1958, p. 55) that asked the question "Will Maintenance Manage Future Plants?"

An answer was given by one West Coast plant manager:

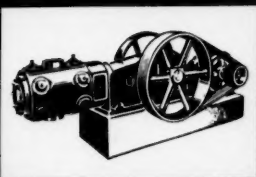
"If I had to pick my successor, I'd give our maintenance supervisor serious consideration for the job. We've already reached the stage where a good production manager has to be a good maintenance man. If he isn't, he will be running a plant that isn't operating."

► **More Engineers Needed**

Most observers agree on the need for more engineers in maintenance, but as to the education they should have, you'll find some disagreement.

Some companies, like Pennsalt, see an additional need for engineers in maintenance rather than any changes in the work they are doing. Norton Brown, their plant engineer in Wyandotte, Mich., feels "... there's no question of the need for the technical service function of maintenance, however, this represents expansion rather than change. In the area of maintenance engineering, the same kind of engineer who did a good job ten years ago can do a good job today."

Most other maintenance



Piston rings made with TFE resins cut replacement and maintenance costs

In a heavy-duty compressor, a set of piston rings and wear rings (shown above) made of a filled TEFLON TFE resin has made possible substantial savings in replacement and maintenance. The rings that were replaced by rings of TEFLON TFE resin cost two and one-half times as much, and lasted less than a week on the average. The rings made with the TEFLON TFE resin were still in operation after three and one-half years of service. According to the manufacturer, maintenance savings amount to approximately \$3,750 labor/year/machine.

The unique combination of properties offered by TFE resins makes possible improved performance, greater reliability and lower costs in all types of floating-ring applications. TFE resins have the lowest static coefficient of friction of any solid material

—less than 0.04. They eliminate problems of slip-stick, and permit the use of non-lubricated rings. In addition, their exceptional resistance to temperature extremes and their complete inertness to almost all chemicals and solvents make them ideal sealing materials under the adverse conditions often encountered in the chemical industry. In everyday seal applications as well, floating rings of TFE resins provide longer life, safer and more reliable operation and reduced maintenance costs.

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

managers have pretty much the same thing to say: Although recruiting and evaluation techniques have improved, the type of engineer they're looking for hasn't materially changed within the last ten years. However, the individual, due to the broadening concepts of maintenance, now has wider fields of activity and opportunity open to him. In many cases, he can now participate to a much greater extent in management.

► **Chemical or Mechanical?**—Here's where you'll find no uniform industry policy—only some noticeable trends.

Some companies try to diversify their engineering talent in the maintenance department so they can handle any type of job. This means companies like Monsanto and Union Carbide Metals hire chemical, mechanical, industrial, civil or electrical engineers.

Many others say they prefer mechanical engineers with few if any chemical engineers hired. Dow's Freeport, Tex., plant, for example, has no chemical engineers in maintenance. On the other hand, their Pittsburg, Calif., plant has an almost even split. Plant manager Lou Simenson says, "In general we prefer mechanical engineers but the lack of this training would not disqualify a man. In fact we now use equal numbers of mechanicals and chemicals in supervisory jobs."

Standard of California (Socal) in San Francisco has much the same attitude, they'll hire men with all types of engineering degrees but emphasis is on chemicals and mechanicals.

And so on down the line. Chemstrand in Decatur, Ala., has engineers in all types of disciplines but the largest number are mechanicals with chemicals running a strong second. Stauffer on the West Coast makes predominant use of chemical engineers in maintenance.

Most chemical companies agree on the growing place for chemical engineers in this field once home base for mechanical engineers. Indicative of this acceptance of the chemical engineer was a recent panel discussion on maintenance problems in the petroleum industry run

by the ASME's Petroleum Div. Of the seven members of the panel (all in maintenance work) three had degrees in chemical engineering, one in industrial engineering and three in mechanical engineering—more than an even split.

This acceptance of chemical engineers signifies a change in thinking. Maintenance is becoming, by necessity, more process minded. Mechanical engineers entering the CPI soon become, in one way or another, process rather than mechanically oriented.

Regardless of academic degree, the need is now for an engineer with good administrative talents; a man who is a manager applying all the recognized tools of management and a key partner in reducing production costs.

► **Engineers Need Training**—This type of man can't come directly from the schools and few ultimately meet all the requirements. Thus, the engineering organization must act as a progressive training group to meet future demands.

Some companies find the answer to this personnel problem by hiring engineers right out of school and using on-the-job training.

Monsanto in St. Louis not only hires right out of school but also interchanges engineers between maintenance, production, design and even research. The same is true at Standard of California where this interchange finds a considerable number of maintenance engineers ending up as operating supervisors or with staff jobs in manufacturing.

Columbia Southern's Corpus Christi plant does it differently; interchange works one-way: operating people come into maintenance but not vice versa.

Also in the Southwest, at Freeport, Tex., Dow uses a formal training program. They hire maintenance engineers right out of school, train and rotate them around, teach them labor and personnel relations and stress economics. After a year, they put them in as assistants to a foreman to learn practical matters. Those with supervisory ability go into that,

others stay in technical work. Engineers can be transferred to maintenance from any plant department.

Pete Gurklis, Dow's Supt. of Maintenance Shops, feels the tendency today its toward college-trained people in maintenance because of its growing complexity. As an example, the engineering department must consult with maintenance in the early plant design stage.

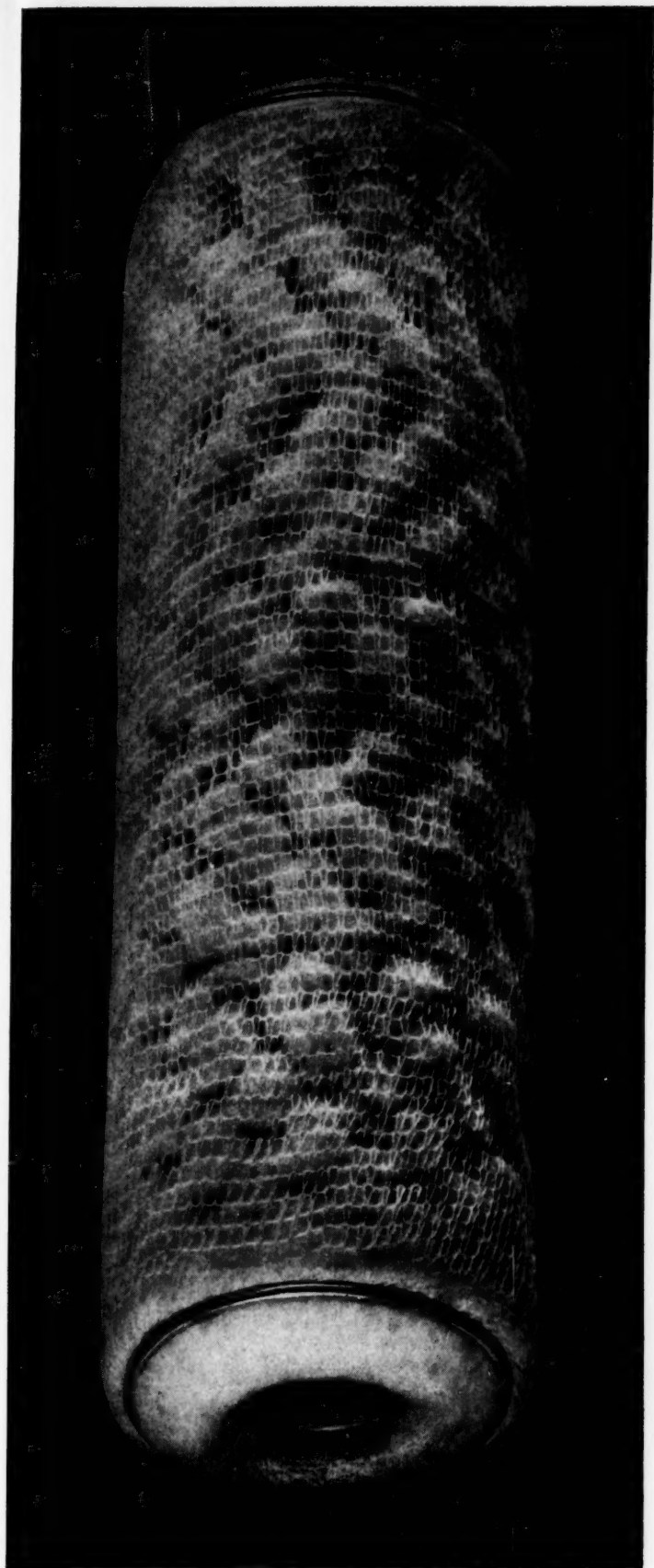
Phillips Petroleum in Bartlesville won't take engineers into maintenance without two or three years' experience in some other area such as design, process or laboratory work. They gain maintenance experience by actually working on the job. Phillips teaches them labor relations and rotates them into operation and design.

► **Bucking the Trend**—In at least one company (Socal), if not in more, there is some indication that there's no rush toward technically trained people in maintenance.

Socal does feel it's true that the future will place more emphasis on better coordination between engineering and maintenance. Also, as processes and equipment become more complex, a continuation of the trend toward heavier technical participation in maintenance is expected. However, this doesn't mean they expect to change their practice of filling field maintenance supervisory positions with nontechnically trained men who have worked their way up from the ranks.

What these changes going on in maintenance mean, Socal believes, is that more will be required from engineers in the way of repair instructions and analysis to assist the field maintenance organizations in their planning and in the actual execution of the work.

Men who have worked their way up from the maintenance ranks, Standard continues, who know all the ins and outs of maintenance jobs from first-hand experience, have a better background to actually head up the maintenance function. Socal feels that such a man can do a better job of maintenance management because he knows maintenance people better.



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cartridge has
increased filter life
as much as 600%

Tested and proved in plant after plant, on the toughest production runs, the new AFCO "Feutron" filter cartridge has given up to 600% longer life . . . 600% more capacity . . . and a cleaner, more uniform product, day after day.

The AFCO cartridge embodies a new filtration principle, featuring custom-engineered fibers of selected diameter and consistent cartridge density throughout the micron range. The unique construction of the filter media guarantees increased solids capacity, lower pressure drop (which permits a higher filtrate rate), and more uniform performance . . . all of which adds up to a more efficient, economical filter cartridge!

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PRACTICE ...

CORROSION FORUM

EDITED BY R. B. NORDEN



LIQUEFIED ETHYLENE now shipped by stainless truck tanker at -155°F . from Sarnia to Montreal, Can.

Over-the-Road Liquid-Chemical Transport . . .

Tankers: Stainless to Plastic Gamut

Truck tankers, handling more and more exotic chemicals, are now available in a great variety of materials of construction. Most corrosion resistant: stainless. The newest: reinforced plastic.

A quiet revolution is taking place in over-the-road tank transportation of liquid chemicals.

The increasing volume and variety of chemicals—from fuming nitric to liquid ethylene—now casually hauled over our major highways, has forced manufacturers to build tankers out of corrosion-resistant materials, including reinforced plastics, aluminum, and various types of stainless steels. Just a few years ago choice was lim-

ited to lined and unlined steel. Ideally a tank transport should:

- Be easily cleaned of cargo residues.
- Require little or no maintenance on the tank shell (inside or out).
- Have a long service life.
- Be capable of handling a variety of chemicals.

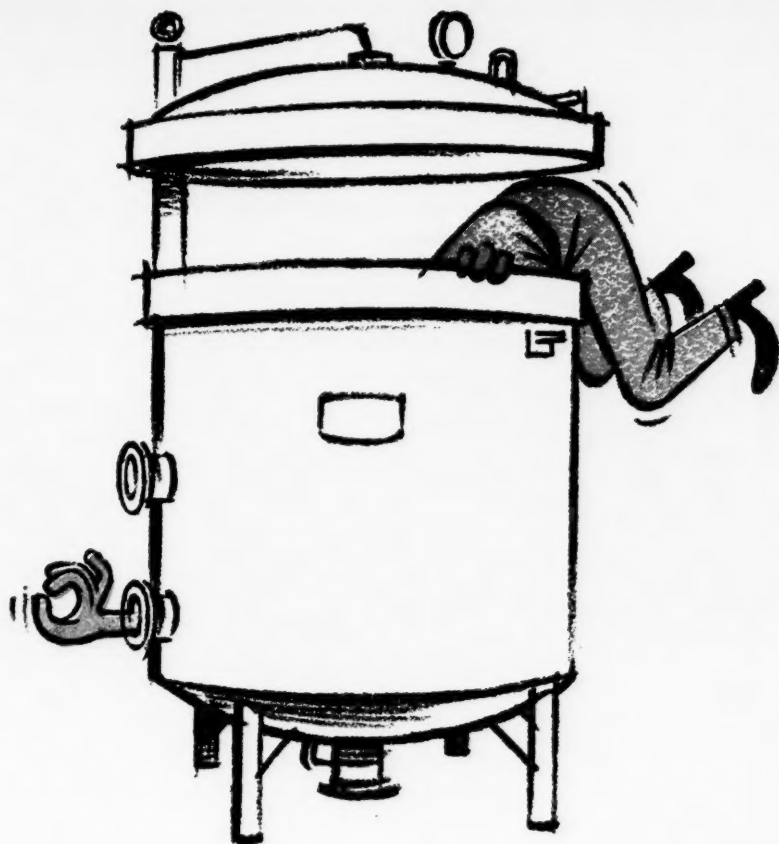
► **Cheapest Tanker**—There is no tanker which meets all these requirements. On a first cost basis, the least expensive tanker

must be made from unlined mild-carbon steel or low-alloy steels.

Purchase cost of an average 4,300-gal., mild-steel tank is around \$6,700 according to 1959 valuation figures.

Within the chemical market, steel tankers comprise about 25% of all such equipment sold in 1959.

Carbon steel and high-strength low-alloy steels have roughly the same corrosion resistance. But the low alloys have a relatively high tensile



A FILTER WORTH LOOKING INTO

You have to look "under the hood" of a Durco-Enzinger filter to really appreciate some of the engineering and design advantages that you get. For example, are you familiar with these **exclusive** Durco-Enzinger features and how they can help you solve your filtration problems?

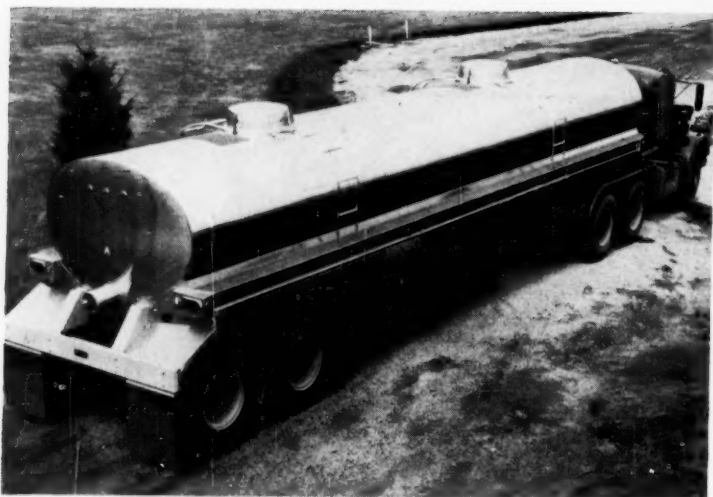
- Finger leaf spacers
- Wingwheel closure
- Tilting leaves
- Oscillating sluice
- Traveling sluice
- Cake thickness detector

Couple all these with a good basic pressure leaf filter design, ASME code construction, rugged leaves and real filtration know-how, and you surely have a filter worth looking to. Write for bulletin EF/2a.



ENZINGER DIVISION

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CHEMICAL-TANKER has two compartments (2,900 and 2,100 gal. above).



PHOSPHORIC-SULFURIC transported in 3,560 gal., 316L tank.

strength, and I.C.C. permits use of thinner gage alloy material in tank construction.

► **Difficult to Clean**—This equipment is popular and successful in transporting many nonoxidizing chemicals—including petroleum products, alcohols, chlorinated solvents—where iron contamination is not a problem. But cleanability of steel tanks, generally, is not very good. Viscous materials usually present a problem if they have to be removed. And only cleaning agents can be used which don't attack steel. Because of this, maintenance costs

of a steel tanker are high when hauling different products.

► **Lining No Panacea**—Actually, unlined steel tankers for chemical haulage are losing out to many of the newer materials. Of course, one way to get around steel's disadvantages is to put a lining on it. And tankers lined with baked-phenolic or rubber have been available for many years. In fact, phenolic-lined equipment is a big factor in transporting strong sulfuric acid. Rubber-lined tanks are very popular in muriatic and waste-sulfuric service.

Again, while they have fair

corrosion resistance, lined tanks can't be cleaned easily. So they suffer from the same disadvantage as unlined steel tanks: little versatility. They essentially are one-product tankers. You can't haul sulfuric in one trip and bring back a high-purity chemical. But steel—lined or unlined—definitely has a place in the handling of large-volume, medium-purity chemicals.*

Clad steel, as a material, is not a factor in tanker construction. Usual steel gages are 10 or 12. Clad steel in these thin gages is difficult to weld and the final tank would cost as much as solid-alloy construction.

► **Stainless Gains**—Certainly, one of the up-and-coming materials for tanker construction is stainless steel.

Stainless is standard for transporting dairy products. But in the chemical industry, stainless tankers are relatively new although fast become the workhorse of the industry.

The cost of stainless tankers came down to a reasonable level—about twice that of carbon steel. Stainless has about 25% of the chemical truck market now and increasing.

Only the 300 series is in demand for chemical transport. Type 304 is the most popular by far. But there is also some 302, 316, 316L, 304L and 347 going into tankers.

One big selling point for stainless is fairly obvious: it has a dense, smooth surface—cargo residues are easily cleaned out. And, of course, corrosion resistance is excellent. Because of this, for really difficult-to-remove chemicals, strong acid or alkali cleaners can be used.

One interesting problem appears to be solved with stainless equipment. Small amounts of nitric acid decompose formic acid. Even traces of nitric forbid transportation of formic in the same container. And until stainless tankers became practical, shipment of nitric with a return of formic couldn't be handled in the same unit with the usual materials of construction. But it seems stainless can

* There are I.C.C. cargo tank specifications for flammable, corrosive and pressurized liquid haulage.



PERMOBOND

For Protection against corrosive attack call for "Permobond Service"

Permobond service entails selection of the right Permobond lining, sandblasting to clean the metal, applying the bonding cement, application of the lining to the equipment.

Permobond Service is the combined facilities and experience of U. S. Rubber's franchised local applicators plus the Permobond Linings.

Permobond Linings protect against corrosion and abrasive attack. Any equipment, new or old, such as pipes, valves, tanks and agitators, is readily and fully protected with an application of Permobond Linings, applied by the franchised applicator in your area.

Here are typical Permobond applications installed by two applicators:

•Kaiser Aluminum & Chemical Corp. (Mulberry, Florida). Huge 100,000 gallon acid-storage tanks lined with Permobond by the applicator, Rubbertec, Inc., Bartow, Fla. The redwood tanks previously used for storage of hydrofluosilicic acid deteriorated rapidly, sprang costly-to-stop leaks, lasted for only 2½ years. Permobond®-lined tanks are expected to last from 15 to 20 years.

•The dredge "Markham", built for the Corps of Engineers, U. S. Army, will work on the St. Lawrence Seaway. Its 42" diameter pipes and the main propeller shafts are protected with Permobond. Permobond will provide longer life for pipes and shafts. Maintenance will be low, efficiency high. Avondale Marine Ways, Inc., New Orleans, Louisiana, both built the dredge and applied the linings.

Many companies in basic chemical manufacturing or chemical processing have for years been profiting from the unique protection of Permobond on equipment both large and small, simple or complex. They have found it to be their best protection against chlorinated brine, muriatic acid and sulphuric acid. Permobond-serviced equipment will withstand temperatures up to 200°F.

Get in touch with "U. S." for Permobond Service in your locality. Mention the type of equipment requiring protection and the type of service.



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be cleaned to remove all traces of nitric, in a matter of a few hours.

► **Molten Chemicals** — Another area where stainless has moved in: molten phthalic anhydride. To ship solid, it must be cooled, then bagged. On receipt, the crystals have to be unpacked, then remelted. It's cheaper to ship the molten anhydride, but this is a heavy, viscous material and difficult to clean out of a tank. Type 347 stainless, in insulated tankers, stands up very well to 366 F. phthalic anhydride. Stainless producers look to a big market just from this type of hauling: hot molten, viscous materials which call for severe cleaning. Of course, here a relatively thick gage must be used to stand high temperatures.

And stainless is popular now for hauling cryogenic chemicals. Ethylene is normally shipped as a gas in small pressurized cylinders. Handling costs are high. Imperial Oil Co., Ltd., Sarnia, Canada, has found one solution.

An all-stainless trailer, 36-ft. long, and 8-ft. in dia. carries 30,000 lb. of liquid ethylene at -155 F. Transport maintains a regular schedule, traveling between Sarnia and Montreal in less than 24 hr. It was built by the Olefins Div. of Union Carbide Corp., for continuous over-the-road service at -155 F.

So-called "green" phosphoric acid requires special handling. Until stainless tankers came into wider use, shipment was difficult, expensive and largely restricted to rail travel. Type 316L stainless tankers is suitable for handling not only phosphoric acid, but also such other forms of liquid fertilizers: ammonia solutions, ammonium phosphate and ammonium nitrate.

► **Aluminum Has 50%** — But stainless has some stiff competition. In a little over 5 yr., aluminum tank transports have become a major factor in chemical and petroleum transportation. Over 50% of the chemical tankers sold during the past year have been constructed of aluminum. Costs are about 1½ times a carbon-steel transport. The reasons for this situation:

development of high-speed, consumable-electrode welding processes which reduced fabrication costs.

The trend now is towards aluminum-magnesium alloys, such as 5052, 5154, 5454, 5086, 5456 and 5083 for tanker construction. This series is very easy to weld. Usual specifications are written for annealed 5052, but many manufacturers are going to the higher strength 5454 alloy, which has superior resistance to stress corrosion. The 5052 specs used with 5454, give an added safety factor (Only the first four in the series are included in I.C.C. specifications).

► **Big Payload** — Aluminum transports are generally more easily cleaned than mild steel, but can't take severe or strong alkali cleaning agents. And, of course, aluminum weighs less than steel, permitting a larger payload.

The list of chemicals carried in aluminum tankers is long and varied. Some typical materials: alcohols, xylenes, acetic, formic, fuming nitric acids, ammonium nitrate solutions, acrylonitrile, dissolved urea, gasoline, petroleum, asphalt. In fact, aluminum is displacing steel for many applications. Hydrogen peroxide is carried in a special aluminum alloy tank, having a very low copper and manganese content.

Producers claim aluminum tankers can be used for multiple shipments—ammonium nitrate solution one way; acetic acid on the return trip. Usually a solvent shipment needs nothing but a good steaming. Other materials call for a strong cleaner.

► **Absorbs Impact** — One other advantage of aluminum: it's ductile and absorbs impact well—important considerations when a tanker, hauling a corrosive liquid, gets involved in a highway accident. Other metals, in this case, might crack, leaking the hazardous material.

One big potential market may give an added boost to aluminum in the trailer-tank field: hauling of cryogenic materials. Aluminum has excellent low-temperature properties, and while aluminum alloys are not a big factor yet in the trans-

portation of low-temperature liquids, they should be within the next few years.

► **Novel Plastic Tanker**—Reinforced plastics — particularly glass-fiber-reinforced polyesters — is a new and novel approach to tank-truck construction.

Plastic trailers are a minor factor in hauling chemicals right now. But producers such as Haveg and Heil are enthusiastic over the possibilities.

For one thing, a reinforced plastic tank is strong and lightweight, permitting big payloads.

A tensile strength of 100,000 psi. is not unusual, compared to 31,000 psi. for aluminum 5454; 90,000 psi. for high-strength steel.

The plastic has a hard, shiny, glass-like surface and tank manufacturers claim it's easy to clean with water spray or detergents (not strong acids).

► **Low Heat Transfer** — Reinforced polyesters are suitable for temperatures up to 225 F. While not "self insulating" they have a low heat transfer coefficient.

Chemicals handled in these tankers include liquid ammonium nitrate, 14% sodium hypochlorite, formaldehyde. Polyesters, however, can't handle strong acids of the sulfuric, nitric, hydrochloric family.

I.C.C. approval is in process, but I.C.C. issues special permits for plastic construction. Typical plastic tanker costs fall somewhere between aluminum and stainless.

Promising Extrusion of Refractory Metals

At Wright Air Development Center, a contract between the Materials Laboratory and Harvey Aluminum is under way to explore fabricability of refractory alloys (molybdenum, tungsten, columbium, tantalum).

Approximately 20 unalloyed molybdenum and 30 molybdenum alloy billets have been successfully extruded. The experimental extrusion of 50% Mo-50% W and unalloyed tungsten (sintered products) has been reasonably successful at a 4:1 extrusion ratio.

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- ✓ A radically new concept in zinc coatings for protecting steel.
- ✓ Under development for many years and first patented in 1957.
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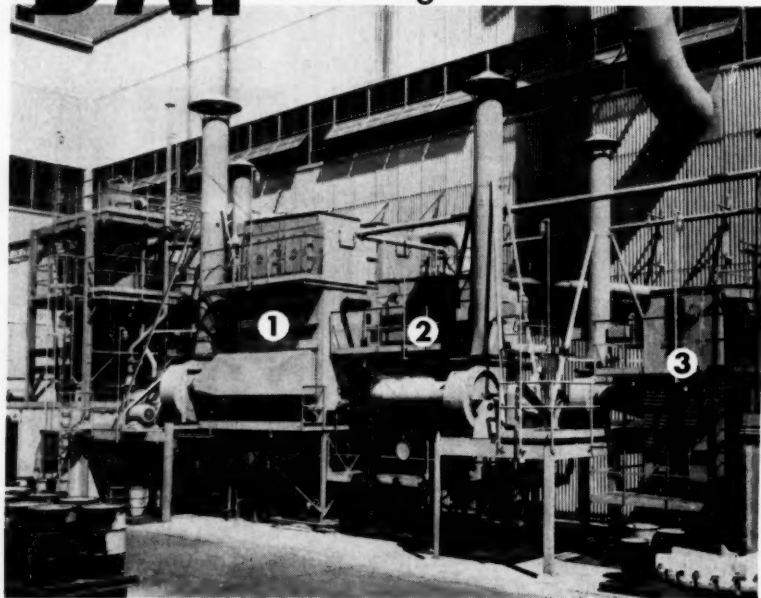
How does Zinkote compare with Dimetcote? Although similar, each has certain unique advantages depending upon the particular requirements of the job. We will be glad to give you a specific recommendation.



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The Pioneer Manufacturer of Inorganic Zinc Coatings

DAY plant proven dust control filtering URANIUM dust



3 DAY "AC" Dust Filters Serve MALLINCKRODT CHEMICAL WORKS URANIUM DIVISION, AEC Weldon Springs Site

Shown above are 3 DAY "AC" dust filters. Filters No. 1 and 2 are collecting magnesium fluoride (MgF_2) slag dust and U_3O_8 from slag grinding and similar operations. Filter No. 3, on the right, serves to filter uranium tetrafluoride (UF_4).

Equipment with high filtering efficiency is an imperative requirement for an installation of this type. These DAY filters meet this requirement. They capture sub-micron particles with 99.99+ % efficiency because they are designed around the Hersey principle of air filtration which uses felted filter media. Filter media porosity is maintained automatically and continuously by high velocity reverse jet air. This assures stable back pressure.

Throughout many industries DAY equipment is preferred because it's *plant proven*. It means DAY not only offers high efficiency and pure, clean air but higher recovery of valuable product. DAY "AC" reverse jet filters are also preferred because they occupy a minimum of space and provide higher air handling capacities (4 to 5 times higher than non-reverse-jet type filters).

For more facts about the services and equipment DAY offers, consult your DAY application engineer, and for complete facts about DAY filters write to DAY for Bulletins F-75 and G-579. They contain helpful planning information and air engineering data.

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Dust Control • Pneumatic Conveying • Bulk Storage
EQUIPMENT . . . SYSTEMS . . . INSTALLATION

INDUSTRY NEWS . . .

(Continued from p. 60)

in Mobay's increasing isocyanate production.

Bzura Chemical Co. is building a 9,000-ton/yr. citric acid unit at its Fieldsboro, N. J., plant. New unit is scheduled for completion by March.



Atomics International, a div. of North American Aviation, has put into operation the largest private-industry bank of remotely operated hot cells shown above. Hot laboratory will service nuclear fuel users, permit visual inspection of irradiated fuel elements.

Pennsalt Chemicals Corp. announces plans for construction of new blending, packaging and warehousing facilities at Atlanta, Ga. New plant, to cost \$500,000, will go into operation this spring.

Medusa Portland Cement Co. announces plans for a \$9-million expansion of production capacity and limestone lands. Latter is part of a \$70-million program including a 1-million bbl./yr. expansion of its Dixon, Ill., plant and modernization of York, Pa., and Toledo, Ohio, plants.

Naugatuck Chemical Div. of U. S. Rubber announces an expansion of vinyl-resin capacity to 32,500 tons/yr. at its

Painesville, Ohio, plant. Expansion planners focus their attention on increasing demand for plastisol resins.

Sonoco Products Co. has announced construction of a \$2-million research center at its main plant in Hartsville, S. C. New center will enable Sonoco to conduct paper and pulping research, as well as develop small pilot units in favorable conditions.

Niagara Chemicals Div. of Food Machinery and Chemical Corp. is adding new blending capacity to its South Haven, Mich., pesticide plant. New equipment is scheduled to begin operation by March to supply the Midwest with new dust formulations.

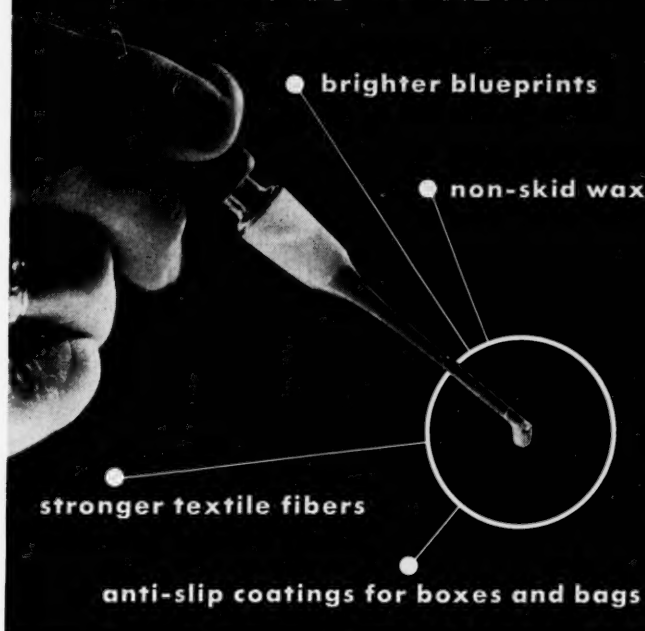
Pittsburgh Coke & Chemical Co. will soon complete increase of sulfuric acid capacity at Neville Island, Pa. PCC will market new acid output, as well as retain some for metal pickling, coke-oven gas processing and chemical manufacture.

Minnesota Mining & Mfg. Co. has started site preparation at its St. Paul, Minn., research center for a \$10-million, 14-story administration building, scheduled for completion early in 1962. Building is part of over-all plan for expansion of 3M research and administrative center from today's seven buildings with 560,000 sq. ft. of space to an ultimate of 30 buildings with about 2.2 million sq. ft. on 265-acre site.



Lithium Corp. of America will acquire the **Fulton-Irgon Corp.** (Dover, N. J.). Active in various phases of rocketry, **Fulton-Irgon** will provide **Lithium Corp.** with research and production ability in the

BILLIONS OF TINY SILICA PARTICLES MAKE...



Silica particles that accomplish these tasks are of millimicron size. There are more than a million billion of them in a single drop of Nalcoag!

Nalcoag[®] COLLOIDAL SILICAS

One enterprising Nalco Lab man poured Nalcoag on his shoelaces to keep them from coming untied. Frictionizing effect was so good it quickly wore the laces to pieces... Back to the test tubes for him.

Making brighter blueprints does not come under the heading of frictionizing—but neither do a lot of other Nalcoag applications in industry. For simple colloids of silica microspheres in water and/or alcohol, the Nalcoags have a remarkable range of *known* uses, and we invite you to help hunt for some of the interesting *unknowns* of possible profit to you.

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Perhaps some of the current places where Nalcoag is at work may show parallel potential for you. They are described, with Nalcoag properties and characteristics in Bulletin K5, available on request.

Nalcoag products in concentrations from 15% to 35% are promptly available.

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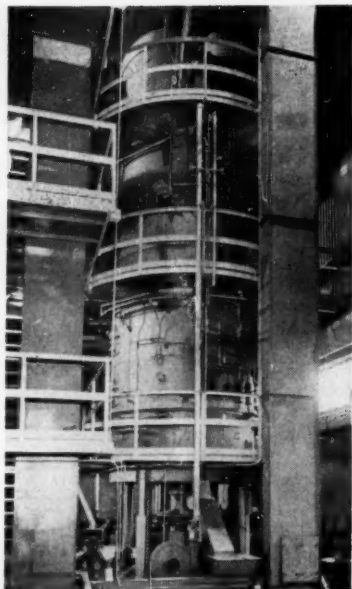
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If you have a
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or Decomposing
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a Skinner Furnace may be the answer

Successful applications of the Skinner Furnace include:

Oxidizing Roast

Roasting Molybdenum Sulphide Concentrates
Roasting Zinc Ores
Calcining of Basic Alum, Clays, Foundry Sand, Carbon, etc.
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Roasting Uranium-Vanadium Ores

Reduction Roast

Decomposition of Oil Sludge
Lime Burning
Manganese Reduction

Drying

Drying Uranium-Oxide Precipitate
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Many other applications are possible because of the flexibility in construction and operation of the Skinner Furnace...

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4'0" to 23'6" dia.
22 to 4000 sq. ft. hearth area
Direct or indirect fired with coal, oil or gas
Variable rate of feed and retention time

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Handles any solids... slimy, sticky, loose, coarse
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200° F. to 2000° F... precise control of process temperature
100 to 50,000 lbs. per hour

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INDUSTRY NEWS...

field of missiles, rockets and advanced aircraft systems.

Courtaulds, Ltd. now has royalty agreement with Glidden, International, giving exclusive rights to use in the United Kingdom of Glidden's development and manufacturing technology. Agreement benefits recent Courtaulds acquisition — paint maker Celcon, Ltd.

Roger Williams Technical & Economic Services, Inc. (Princeton, N. J.) has acquired the British consulting firm of George Lewi and Partners (London). Addition enables Williams to apply U.S. market research techniques to the European market for its clients and thus keep abreast of the European Common market and Outer Seven.

Dept. of Defense will open, early in 1960, a large plastic technical evaluation center at Picatinny Arsenal (Dover, N. J.). Center will try to narrow the gap between research and applied engineering by collecting, evaluating, storing and disseminating technical information in a manner similar to Battelle's titanium center.



OVERSEAS BRIEFS

Egypt: United Arab Republic's Ministry of Industry announces establishment of Hoechst-Egypt, S. A. A. to produce antibiotics, antihistaminic and analgesic drugs in Egypt.

New Zealand: Construction will start soon on a \$7.5 million mill to roll 5,000 tons/yr. of sheet aluminum from Canadian ingots. Built near Auckland by the Northern Aluminium Co. of England, plant will be New Zealand's first of its kind. Meanwhile, the Australian firm, Consoli-

Massco-Grigsby

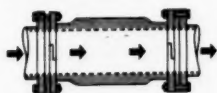
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Rubber—Neoprene
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- 1" to 14" inside diameter.
- Pressures to 150 psi.
- Temperatures to 200° F.
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.
- Cannot leak or stick.
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- Unobstructed flow eliminates high friction loss.
- Remote control available.
- Can be equipped for automatic regulation.



- Split flanges and patented Flex Seal ends assure perfect seal.
- Closing mechanisms... manual handwheel; handwheel with chain and sprocket reduction unit; electric worm gear motor reducer; chain operated torque arm reducer; hydraulic; air-hydraulic.

WRITE FOR NEW CATALOG...

gives complete data, including list of recommended applications.

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... INDUSTRY NEWS

dated Zinc Proprietary, Ltd., is investigating the possibility of developing sufficient hydro-generated electric power in New Zealand to smelt Australian alumina.

Singapore-Malaya: Two overseas Shell companies plan construction of new refineries in the Far East. Shell Co. of Singapore, Ltd. will build a \$12.9-million refinery in Singapore; Shell Co. of Malaya will build a \$20.6-million refinery in Malaya.

Italy: Parke, Davis & Co. has begun construction of a new \$1-million pharmaceutical manufacturing plant at Milan. Existing facilities in Rome will expedite product distribution in southern Italy.

Moroccan government announces open bidding on a \$60-million contract for construction of the nation's first steelmill complex. Construction should begin by the end of the year, will include establishment of steel and ferromanganese capacity, two railway lines and a seaport.

India: Bombay industrialists collaborating with American interests have won government approval for proceeding with the Koyna Aluminum Project, a 20,000-ton/yr. aluminum ingot plant in Bombay state. Approval includes access to nearby bauxite deposits; caustic soda plant to produce 10 tons/day will be part of project.

England: Within five years, Steel, Peech & Tozer of Rotherham, branch of U.S. Steel, will raise its capacity by one third, will be the largest electric steel-making plant in the world with 1.35 million tons/yr. capacity. Six, 110 ton (long) electric-arc furnaces will replace the open hearths. Total tab—\$28 million.

Tunisia: The Bourghiba government is considering bids for refinery to process crude petroleum which Edjele-Skira pipeline will start delivering into country this year. Both

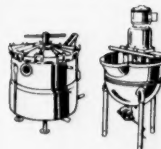


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Complete line includes tanks, coils, vacuum kettles, revolving pans, tubular heat exchangers, pilot plant units and special specification equipment.

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Used by industries the world over to mix and/or blend a complete batch of dry, free-flowing ingredients in one-minute cycles. Exclusive design prevents material separation or particle breakdown regardless

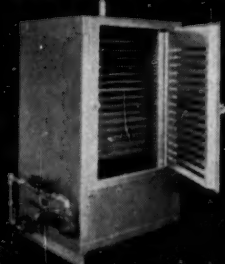
of densities. Fast loading, unloading. Easy to clean.

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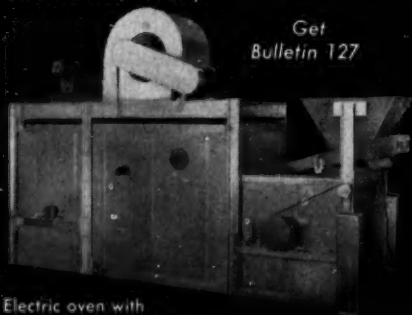
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Convection heating for fast, uniform heat processing

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Bulletin 127



Electric oven with belt conveyor and feed hopper.



Truck type, indirect gas-heated oven.

W. S. ROCKWELL COMPANY 2300 ELIOT STREET
FAIRFIELD, CONN.

INDUSTRY NEWS . . .

Standard Oil and Shell have offered to erect 500,000-metric-tons/yr. refineries at Tunis. ENI, the Italian state-owned gas and oil monopoly, proposes a 1-million-tons/yr. refinery at Skira sweetened by projects for oil prospecting and a products distribution network in Tunisia.

Italy: St. Gobain, French glass maker, has opened new plant at Caserta, near Naples, with annual capacity of 14 million ft. of polished plate glass and 19.6 million ft. of patterned glass.

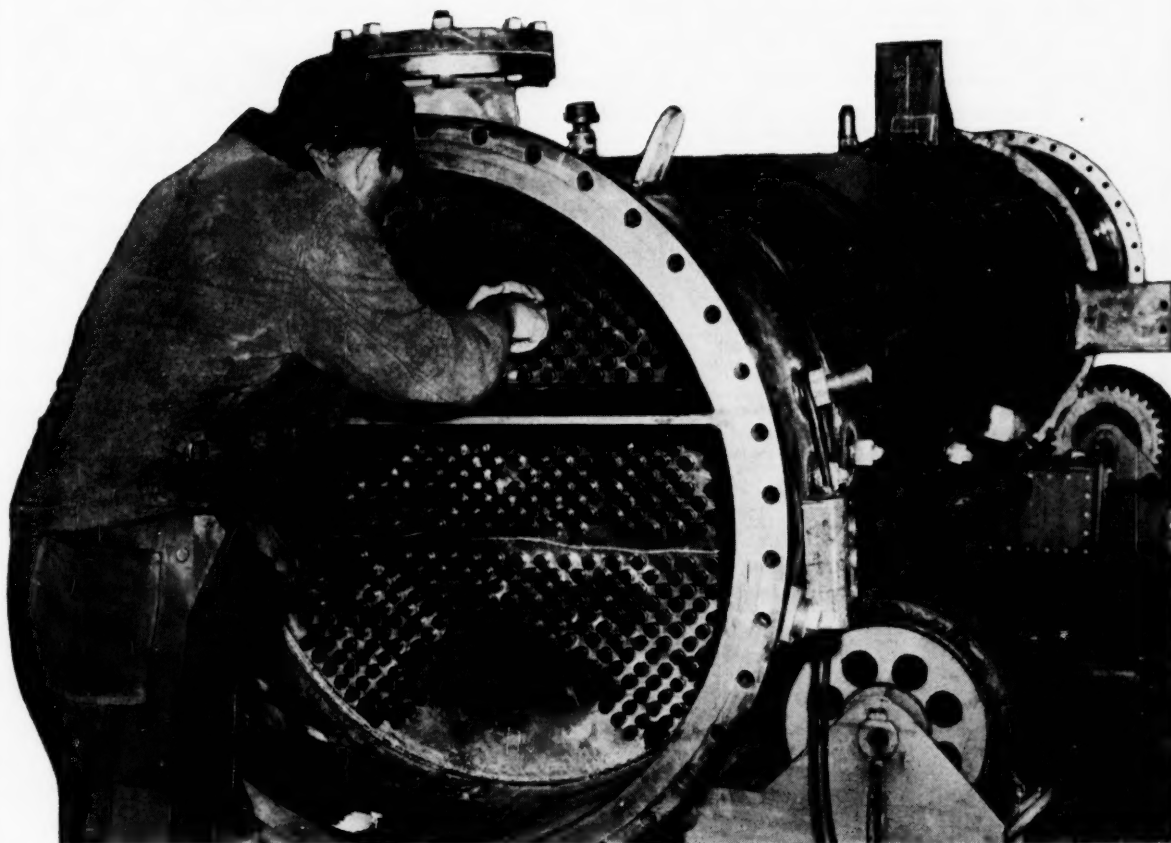
Korea: U.S. Development Loan Fund will loan \$5.6 million to Orient Chemical Co. for construction of plant able to produce 37,000 tons of soda ash, 4,900 tons of caustic soda and 2,450 tons sodium bicarbonate annually. Startup is scheduled within two years.

U.S.S.R.: New chemical center planned by Azerbaijan, near Sumgait, Baku district, will produce polyethylene, acetylene monoethylene glycol and polyvinylchloride from natural gasoline and LPG. Reaching full output in 1965, it will increase Azerbaijan output of synthetic organics 17 fold.

Germany: Du Pont joins Sachtleben AG Fuer Bergbau and Chemische Industrie in formation of Pigment-Chemie GmbH which will produce titanium dioxide pigment in 18,000-ton/yr. plant at Homberg. Du Pont will own 26% of \$8.33 million venture, will supply process know-how and help plan new plant to be completed within the next two years.

Spain: Production of nitrogen has started at a new 15,000-ton/yr. plant in Puertollano as part of a gasoline and lubricant plant operated by the governmental concern, Empresa Nacional Calvo Sotelo. Both the gasoline plant, which uses shale-oil feed, and the nitrogen plant were built by the German firms of BASF and Lurgi.

Waste heat turns into \$40,000 saving thru *Carpenter* Stainless Tubing



Reclaiming valuable heat from spent black liquor vapors is a real money-saving operation with this 2600 sq. ft. 3-pass surface condenser. In the process of condensing distillation products out of a heat vapor line from a multiple-effect evaporator, the unit extracts over 19 million Btu's per hour from these vaporous products and entrained non-condensable sulphides. With this recovered heat, clean filtered water used for washing bleached pulp and other plant operations is pre-heated 25 to 30°F. Steam demand on the mill's boilers for water heating is thereby greatly reduced and fuel consumption cut. The net result of this heat recovery operation is a saving of approximately \$40,000 yearly.

Contributing importantly to the success and economy of this recovery unit is Carpenter Type 304 Stainless Heat Exchanger Quality Tubing. High operating efficiency is sustained, downtime and maintenance are minimized, loss of capacity due to scale formation is avoided and long tube life is assured. Close uniform tolerance of the tubing saves installation time and costs. As a result, the use of this stainless tubing has become standard practice

in these surface type condensers for black liquor evaporator service.

Now you can get cost-saving Carpenter Stainless Heat Exchanger Quality Tubing from our large mill stocks. Types 304 and 316 are available in all popular sizes and gauges. Contact our nearest office for prompt, helpful service on your next order. Send for our up-to-date Selecting and Buying Guide, Bulletin T.D. 120, The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

*your master key
to cost savings
in pulp mills*



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BULK ELEVATOR CONVEYOR

The remarkably different conveyor that permits rapid, economical handling of bulk loads without breakage, marring or dusting... Ideal for elevating, lowering or transferring raw or processed chemicals, even liquids and semi-liquids. Illustrations show the exclusive ECON-O-LIFT operation:

- Exclusive ECON-O-SPACER action moves spaced trays **TIGHTLY TOGETHER** into interlocking bank at loading point... no spillage is possible between trays... no feeder required... simple hopper feed or direct feed-in from any source.
- Trays resume spaced relation and remain spaced and upright at all times—even at turns—except at load and unload points.
- Trays turn upside-down **ONLY** at unloading point for dumping, quickly return to horizontal for travel... no fall-out at turns.

How many handling operations in YOUR plant can be performed smoother, easier and more economically with an ECON-O-LIFT?

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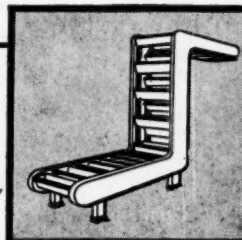
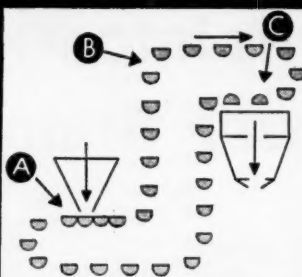
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CALENDAR

Executive Leadership Seminar, Cornell University—University of Arizona, fee: \$600.
Jan. 24-Feb. 5 Tucson, Ariz.

American Institute of Electrical Engineers, national meeting.
Jan. 31-Feb. 5 New York, N. Y.

American Society of Heating & Air Conditioning Engineers, annual conference and Southwest Exposition, Memorial Auditorium—Baker Hotel.
Feb. 1-4 Dallas, Tex.

Instrument Society of America, Instrument and Automation Conference and Exhibit, Sam Houston Coliseum.
Feb. 1-5 Houston, Tex.

American Society for Testing Materials, committee week, Sherman Hotel.
Feb. 1-5 Chicago, Ill.

Society of the Plastics Industry, Reinforced Plastics Div. meeting, Edgewater Beach Hotel.
Feb. 2-4 Chicago, Ill.

Western Industrial Isotopes Conference, cosponsored by Stanford Research Institute and the University of California, for program contact Conferences Dept., Berkeley campus.
Feb. 3-5 Menlo Park, Calif.

American Society for Metals, metals conference, Fairmount Hotel.
Feb. 4-6 San Francisco, Calif.

Symposium on Gas-Cooled Nuclear Reactors, Franklin Institute—American Nuclear Society.
Feb. 10-11 Philadelphia, Pa.

American Institute of Mining, Metallurgical and Petroleum Engineers, annual meeting, Statler and McAlpin Hotels.
Feb. 14-18 New York, N. Y.

The Australasian Institute of Mining & Metallurgy, Symposium on Hydrometallurgy, S. Australian Dept. of Mines.
Feb. 16-19 Thebarton, Australia

National Society of Professional Engineers, winter meeting, Broadview Hotel.
Feb. 18-20 Wichita, Kan.

American Institute of Chemical Engineers, national meeting, Biltmore Hotel.
Feb. 21-24 Atlanta, Ga.

Technical Assn. of the Pulp and Paper Industry, annual meeting, Commodore Hotel.
Feb. 22-25 New York, N. Y.

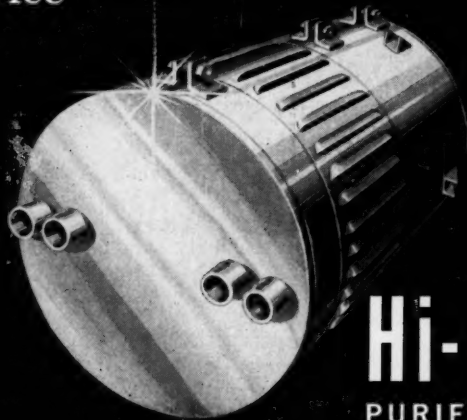
Weed Society of America, biennial meeting, Cosmopolitan Hotel.
Feb. 22-25 Denver, Colo.

Natural Gas Engineering Conference, Oklahoma State University.
Feb. 23-25 Stillwater, Okla.

Pittsburgh Conference on Analytical Chemistry and Spectroscopy, Penn-Sheraton Hotel.
Feb. 29-Mar. 4 Pittsburgh, Pa.

American Society of Mechanical Engineers, Gas Turbine Power con-

prevent product mist carryover
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Prevent valuable particles from leaving evaporators and concentrators. Remove mists detrimental to pipeline processes. Patented Hi-eF, two-stage design principle eliminates use of screens, filters or moving parts. Compact, low-cost and maintenance free! SPECIFICATION MANUAL 803 contains data on 13 types of purifiers, separators, mist extractors, scrubbers. Write.

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Reliable Control Units for every industrial application

Among the many hundreds of Allen-Bradley push button and control units, you are certain to find the types best suited to your particular needs. The seven units shown below are a few of the latest additions to the Allen-Bradley *quality* line of control units.

All Allen-Bradley control units—standard duty, heavy duty, and oiltight—have double break, silver alloy contacts—to assure reliable operation. Simple constructions and generous wiring room are outstanding features. Insist on Allen-Bradley control units for *all* of your equipment—you can't go wrong!

NEW

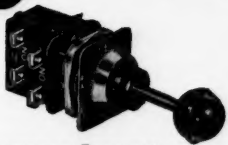
Push-to-Test Pilot Light.
Oiltight Bulletin 800T.



Illuminated Push Button.
Combines pilot light and push button in one unit. Oiltight Bulletin 800T.



Four-way or Two-way Selector Switch. Oiltight Bulletin 800T.



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Encapsulated Pilot Light.
Oiltight Bulletin 800T.



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Delay is adjustable from 0.5 second to 5 seconds. Oiltight Bulletin 800T.



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Life in these excited states...

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Corrosion is embarrassing

It's expensive, too. Not only in terms of equipment chewed up, but also in un-timely time losses and wasted ingredients. You save embarrassment and expense *both* with Ace chemical resistant piping, valves, pumps, tanks, and special lined equipment. 108 years' experience at your service.

All-purpose rigid PVC, Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

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World's best chemical valves... at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ¼" pet cocks to 24" gate valves.

VALVE HEADQUARTERS



ACE

processing equipment of rubber and plastics

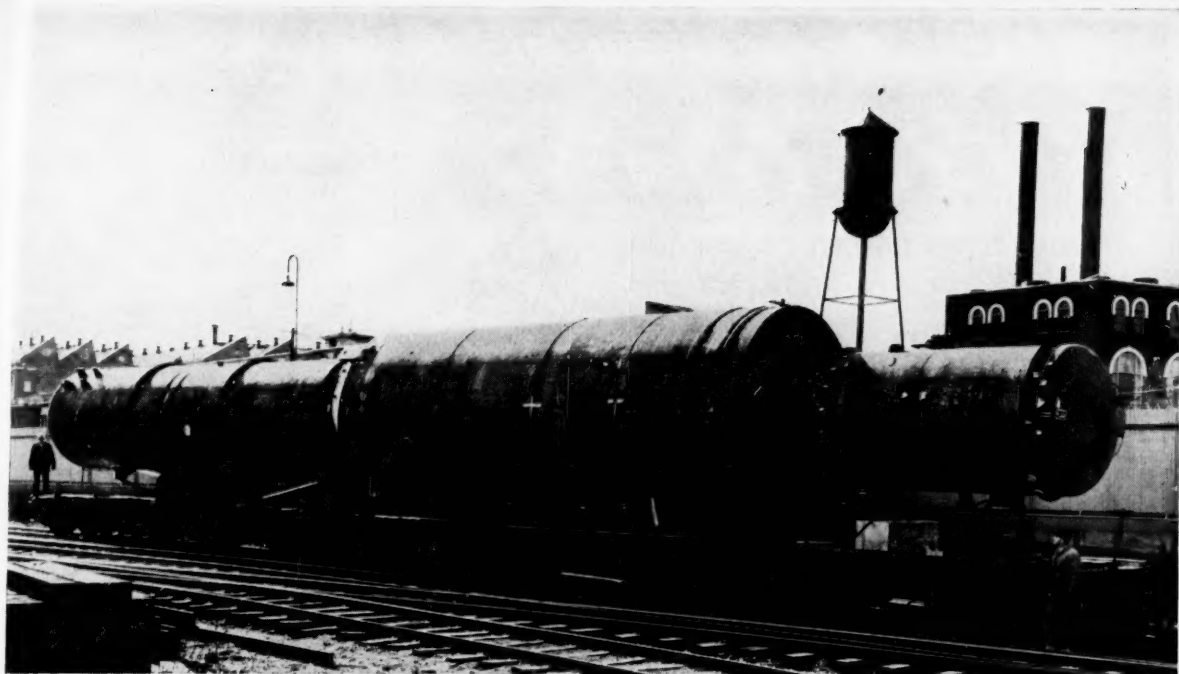
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ACE



CALENDAR . . .

- ference and exhibit, Rice Hotel.
Mar. 6-9 Houston, Tex.
- American Society of Mechanical Engineers**, Hydraulic Conference, Rice Hotel.
Mar. 6-9 Houston, Tex.
- Instrument Society of America**, Temperature Symposium, Deshler-Hilton Hotel.
Mar. 9-11 Columbus, Ohio
- The Fiber Society**, spring meeting, Roosevelt Hotel.
Mar. 10-11 New Orleans, La.
- American Concrete Institute**, annual convention, Commodore Hotel.
Mar. 14-17 New York, N. Y.
- National Assn. of Corrosion Engineers**, 16th annual meeting, Memorial Auditorium.
Mar. 14-18 Dallas, Tex.
- Colorado Mining Assn.**, national Western Mining and Energy Conference, Hilton, Hotel.
Mar. 17-19 Denver, Colo.
- Institute of Radio Engineers**, national convention, Waldorf Astoria Hotel & New York Coliseum.
Mar. 21-24 New York, N. Y.
- Oil Trades Assn. of New York**, meeting, Waldorf Astoria.
Mar. 23 New York, N. Y.
- New England Gas Assn.**, annual meeting, Statler-Hilton Hotel.
Mar. 24-25 New York, N. Y.
- Textile Research Institute**, annual meeting, Hotel Commodore.
Mar. 24-25 New York, N. Y.
- Western Petroleum Refiners Assn.**, annual meeting, Hilton Hotel.
Mar. 28-30 San Antonio, Tex.
- American Power Conference**, sponsored by Illinois Institute of Technology, Hotel Sherman.
Mar. 29-31 Chicago, Ill.
- American Oil Chemists Society**, meeting, Baker Hotel.
April 3-6 Dallas, Tex.
- Nuclear Congress**, sponsored by Engineers' Joint Council and Engineering and Scientific societies, New York Coliseum.
April 3-8 New York, N. Y.
- Instrument Society of America**, National Chemical and Petroleum Symposium.
April 5-7 Rochester, N. Y.
- Management Seminar**, sponsored by Cornell University, fee: \$900, Statler Inn, Cornell Campus.
April 13-26 Ithaca, N. Y.
- American Society of Lubrication Engineers**, annual meeting and exhibit, Netherland-Hilton Hotel.
April 19-21 Cincinnati, Ohio
- Oklahoma State University**, heat-transfer conference.
April 20-22 Stillwater, Okla.
- Instrumentation for the Process Industries**, symposium sponsored by Texas A. & M.
April 20-22 College Station, Tex.
- American Society of Mechanical Engineers-Society for Advancement of Management**, Management conference, Statler-Hilton Hotel.
April 21-22 New York, N. Y.

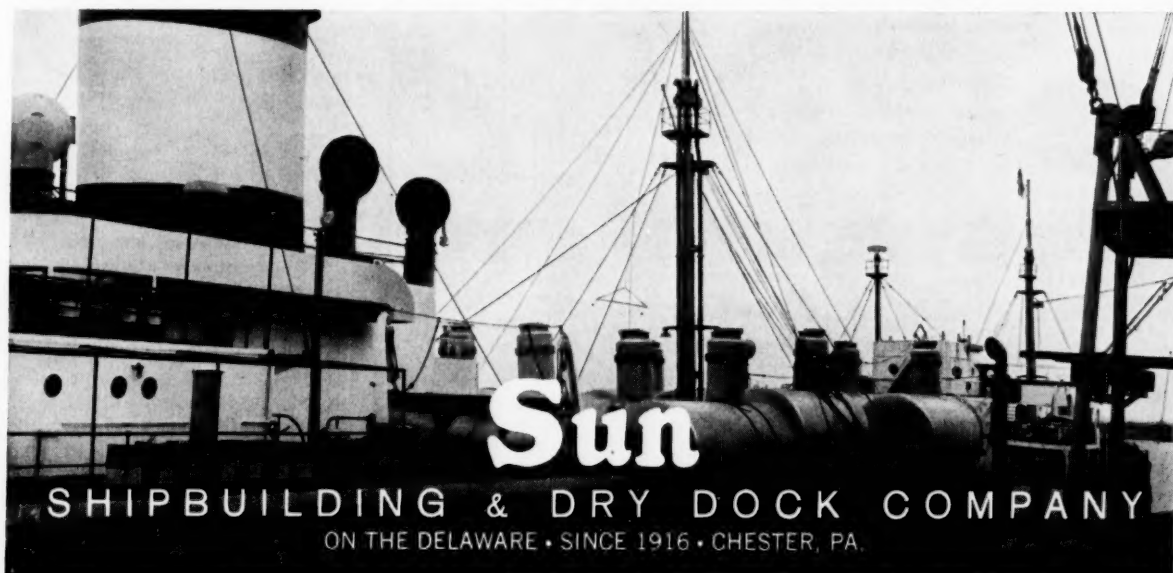


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SOLVES PROBLEMS IN SHIPPING PROCEDURE

The variety of large-size work which Sun Ship's shops produce is matched by a variety of equally important shipping problems. Sun's facilities for shipping by water (overseas, coastal, or inland)—directly from our plant, are often the most economical available, and when large pressure vessels, such as those shown here, are scheduled for overseas shipment, direct, plant-to-ship loading saves additional time and expense.

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for reinforced branch connections
on carbon steel and alloy pipe

Welding fittings manufactured and tested in accordance with ASA B16.9 and ASA B31.1



RESULTS? OVER 4½ TIMES MAXIMUM OPERATING PRESSURE



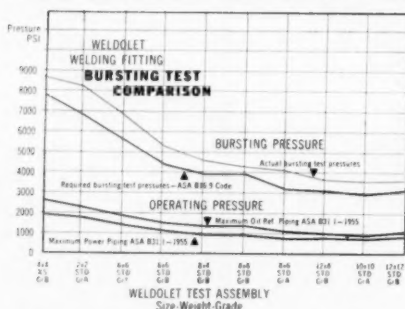
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CARBON STEEL
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for all services



For high strength and low-total installed cost compare with . . . other reinforced branch construction . . . unreinforced branch construction . . . and welding tee construction. Then specify and use Weldolet fittings for all full size and reducing branch connections.

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FORGE** AND TOOL WORKS
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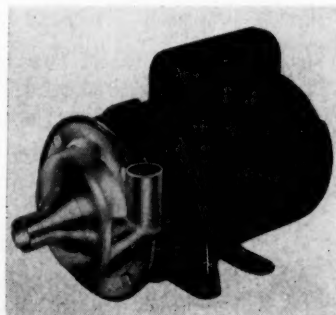
NEW EQUIPMENT . . .

(Continued from p. 78)

duced to the U. S. last month, the Vibro-Energy Mill utilizes a patented gyratory system for both wet and dry grinding.

Company officials claim that this equipment will "obsolete the ball mill for many industrial applications" because of the new machine's ability to process materials at lower costs, and to grind them more finely. Jointly developed by William Boulton, Ltd., and W. Podmore & Sons, Ltd., both of Stoke-On-Trent, England, Vibro-Energy Mills will be manufactured and marketed in the U. S. by Southwestern Engineering Co.

In operation, the machine applies high-frequency vibrations and circular movements to a cylindrical form of grinding media, which in turn grinds the raw-material feed. Space requirement is that of a ball mill for comparable output. Final product size extends into the submicron range.—Southwestern Engineering Co., Los Angeles, Calif. 78E



Centrifugal Pump

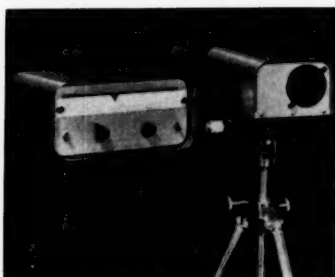
Corrosion-service unit offered in several sizes.

Centrifugal chemical pumps having 14-gage stamped and drawn housings made of corrosion-resistant alloys claim substantial reduction of initial cost, weight and size. Smooth interior surfaces lead to high pumping efficiency, says the manufacturer.

For abrasive conditions, a double mechanical seal with a pressurized oil chamber assures

exclusion of abrasive matter from sealed faces, thus prolonging life. Stock materials of construction include stainless, brass and Monel. On special order, materials can include titanium, tantalum and zirconium.

Offered size range covers $\frac{1}{4}$ to 2 hp.; capacity of 90 gpm. and heads to 100 ft.—**R. S. Corcoran Co., Joliet, Ill.** 146A



Industrial Radiometer

Measures the temperature of distant surfaces.

When surfaces are inaccessible to ordinary temperature monitoring as a result of motion or location, a new industrial instrument may be able to do the measuring job. For the unit, a typical area of measurement is 1 in. at a distance of 40 in. Temperatures upward of 120 F. can be measured, hotter objects lending themselves to the use of smaller measuring areas.

Pictured above is a model that has a servo drive for the null-balance measuring system. Another model is available with a manual balance. Both instruments calibrate to suit the particular emissivity of surfaces being monitored. — **Williamson Development Co. Inc., West Concord, Mass.** 147A

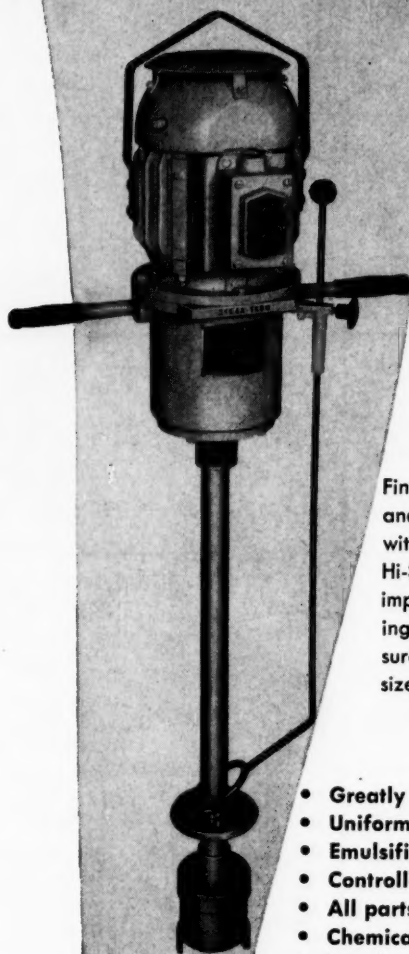
Process Chromatograph

Pneumatic controls make plant automation possible.

Use of chromatographs with pneumatic controls for continuous process control has been, in the past, a task normally tackled by the using firm's own re-

SHEAR-FLOW

**the
modern
mixer
with
power
shearing**



Finer, faster blending, dispersing and homogenizing is now possible with Shear-Flow's new Model RL Hi-Shear Head. Finely spaced dual impellers induce considerable shearing action and high pumping pressures that rapidly reduce particle size for superior material mixtures.

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- Emulsifies immiscible liquids
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- ☐ Have representative call
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DENVER Equipment

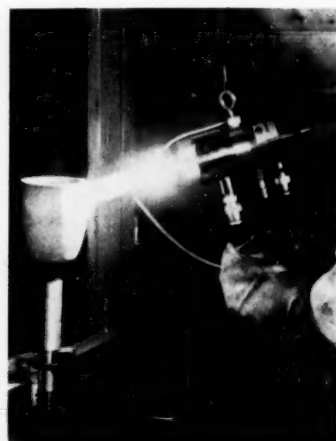
FOR THE CHEMICAL PROCESS INDUSTRY

NEW EQUIPMENT . . .

search and development teams (*Chem. Eng.*, Nov. 2, 1959, p. 34). Now, an instrument company is offering an off-the-shelf system to any manufacturer.

A pneumatic control, developed jointly by CEC and Taylor Instrument Co.'s, stores peak values from a standard CEC Type 26-202 process chromatograph, and uses these values as the basis for process control until the next peak value is supplied by the chromatograph. Such an analyzer can detect a deviation in final product purity, and can take self-corrective steps to bring the process back in line.

Pneumatic system includes a potentiometer transducer to convert millivolt output of the chromatograph to pneumatic output. This component, modified with memory storage, retains the value of selected peaks. A pneumatic recorder-controller records chromatogram peaks and controls by stroking a valve directly or by resetting the control point of another controller that operates the valve. Analyzer has explosion-proof housing.—Consolidated Electrodynamics Corp., Pasadena, Calif. 147B



Plasma Spray Gun

Pushbutton machine applies refractory coatings.

Developing normal work temperatures of 10,000 to 15,000 F., the Metco plasma flame spray gun provides a practical means

 <p>DENVER AGITATORS AND MIXERS Agitator types available: Turbine-type propeller (to 120" in tanks to 50' dia.), slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units. Write for Bulletin No. A2-B2 Lab and pilot scale agitators in L63-B10</p>	 <p>DENVER DIAPHRAGM PUMPS Stroke can be adjusted while pump is operating. Long wearing nylon-reinforced rubber diaphragm. Sizes 1" to 10" simplex and duplex, capacity to 1000 g.p.m. Write for Bulletin No. P8-B12 Lab and pilot scale diaphragm pumps in L63-B10</p>
 <p>DENVER ATTRITION SCRUBBERS High power input to efficiently remove sand coatings, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56" x 56". Write for Bulletin No. A-8505 Lab and pilot scale scrubbers in L63-B10</p>	 <p>DENVER VERTICAL CENTRIFUGAL PUMPS For handling frothy liquids or coarse, sandy slurries, constant or intermittent flow. No packing gland or sealing water. Standard or stainless steel construction. Capacity to 450 g.p.m. Write for Bulletin No. P10-B5 Lab and pilot scale vertical centrifugal pumps in L63-B10</p>
 <p>DENVER BALL AND ROD MILLS Offer operation and convertibility. Wet or dry grinding systems. All steel construction. Ceramic or rubber linings available. Sizes to 10' x 20'. Write for Bulletin No. B2-B20 Lab and pilot scale mills in L63-B10</p>	 <p>DENVER SRL (RUBBER LINED) PUMPS High efficiency, low horsepower. Parts last longer, cost less. Rubber lined. PUMPS AND PARTS IN STOCK. Sizes to 5000 g.p.m. Write for Bulletin No. P9-B10 Lab and pilot scale SRL pumps in L63-B10</p>
 <p>DENVER JAW CRUSHERS Cast steel frame, anti-friction side bearings and bumper bearings. Mangenese steel jaw and cheek plates. Sizes from 2 1/4' x 3 1/2' to 36" x 48". Write for Bulletin No. C12-B12 Lab and pilot scale crushers in L63-B10</p>	 <p>DENVER SAMPLERS Continuous mechanical and automatic types for dry, solution or slurry sampling. Complete sampling plants and sample processing equipment. SAMPLERS IN STOCK. Write for Bulletin No. S1-B4 Lab and pilot scale samplers in L63-B10</p>
 <p>DENVER REAGENT FEEDERS Both wet and dry feeders available. Let us know your requirements. Many standard units in stock. Write for Bulletin No. F6-B8 Lab and pilot scale feeders in L63-B10</p>	 <p>DENVER-DILLON SCREENS For efficient wet or dry screening. "True-Circle" eccentric action. Sizes to 6' x 14' in stock. Also Trommel Screens in sizes from 30" x 60" x 120". Write for Bulletin No. S3-B15 Lab and pilot scale screens in L63-B10</p>
 <p>DENVER "SUB-A" FLOTATION Universal tank with three types of mechanisms: (a) "Cell-to-Cell"; (b) "Free-Flow"; (c) Type "M". Sizes from 16' x 16' to 72' x 72". Write for Bulletin No. F10-B86 Lab and pilot scale flotation in L63-B10</p>	 <p>DENVER SPIRAL RAKE THICKENERS Move settled materials to center in one revolution. Simple, efficient, heavy-duty gear mechanism for thickeners to 150' dia. Acid proof construction available. Write for Bulletin No. T5-B6 Lab and pilot scale thickeners in L63-B10</p>

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EQUIPMENT COMPANY

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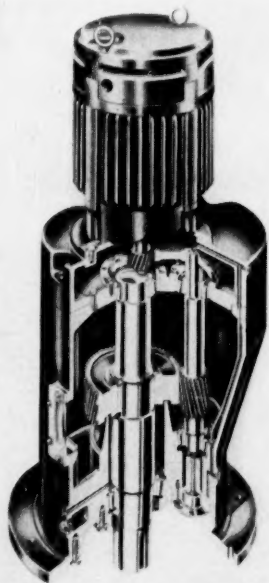
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997-1004 IN CEC.

DENVER TESTING FACILITIES

You will have problems in crushing, grinding, settling and possibly concentration and filtering. These are our specialties so please let us help you in our Test Department. Deco flowsheets are reliable and proven.

of applying coatings of high-melting-point materials to surfaces requiring high-temperature resistance. Typical coating materials include tungsten, tungsten carbide, zirconium boride, etc.

Operating with inexpensive gases such as nitrogen and hydrogen, the gun generates heat at a cost about half that of an oxy-acetylene device. Coating densities approach 98% theoretical. Use of inert gases eliminates flashback and explosion hazards. Training of operating personnel is claimed to be very simple.—**Metallizing Engineering Co., Westbury, N. Y. 148A**



Fluid-Mixer Drive

Major improvement on gear drives of mixer line.

Philadelphia Gear Corp.'s mixers are now available with gear drives having case-hardened, precision-ground gears for greater load-carrying capacity and longer life, with reduced sound level and vibration.

With the new drives, mixer "running in" periods and resulting wear are eliminated. Dynamic load factors are lower, and gearing has a greater degree of accuracy. Offered on vertical fluid mixers in standard



Spotless boiler room with fully modulated CB boilers has been termed by visitors "the most beautiful we've ever seen." Stress is on automatic operation from winter heating to summer cooling.

MODERN as the buildings they heat...

Two compact, efficient, automatic CB boilers heat five new buildings for International Minerals and Chemical Corporation

Precision and quality are a must for this company which produces minerals and chemicals for industry and agriculture. It's an attitude that carries over to the equipment they buy. That's why they installed two 100-hp Cleaver-Brooks boilers to heat their dramatic new headquarters at Skokie, Ill.

According to Callix E. Miller, A.I.A. Project Manager for IMC, "Our Cleaver-Brooks automatic packaged boilers are efficient and quiet." He added, "Their styling and performance are in keeping with functional design that characterizes our new headquarters."

W. J. Mullineaux, Plant Engineer, reports, "Cleaver-Brooks four-pass, forced-draft design has proved it can keep our operating costs low. The CB boilers fit in well with the automatic system we have and simplify our entire operation. Hinged doors make routine inspection easy."

Architects and Engineers on the job were Perkins and Will. Builder was Turner Construction Company.

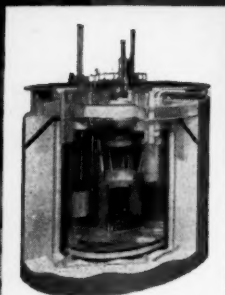
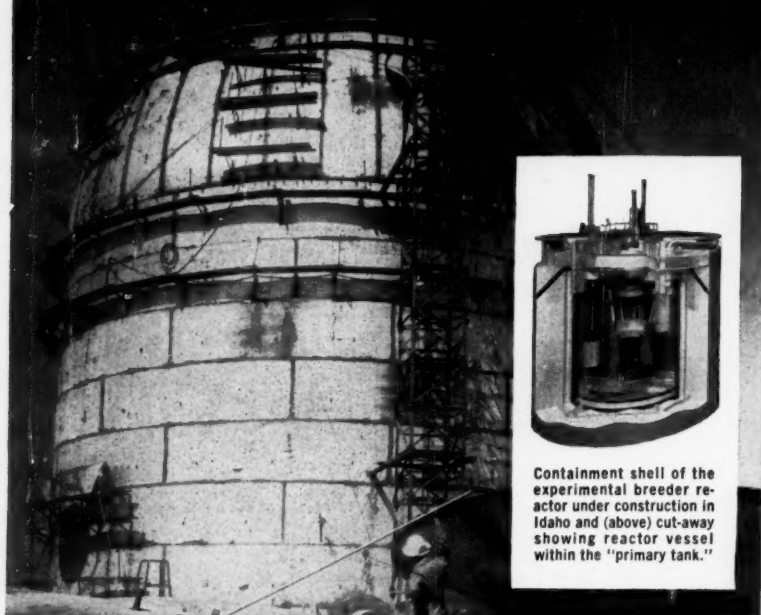
For complete information on Cleaver-Brooks packaged boilers like those installed at IMC, contact your representative or write direct to Cleaver-Brooks Co., Dept. A, 345 E. Keefe Ave., Milwaukee 12, Wisconsin, U. S. A.

Cleaver  Brooks®
ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

IMC headquarters buildings that are heated by CB boilers include the operations building and annex, administrative building, and employees' lounge-cafeteria.



ARGONNE NATIONAL LABORATORY WILL USE...



Containment shell of the experimental breeder reactor under construction in Idaho and (above) cut-away showing reactor vessel within the "primary tank."

ELECTRODYNE
AUTOMATIC VALVE CONTROLS

FOR EXPERIMENTAL BREEDER REACTOR IN IDAHO



Electrodyne will be used by the Argonne National Laboratory as the control for the reactor vessel cover hold-down mechanism in the new experimental breeder reactor EBR II at the National Reactor Testing Station near Idaho Falls, Idaho.

EBR II is a "closed cycle" power plant, where nuclear fuel will be employed to produce heat and at the same time make additional fuel by a "breeding" process. The partly spent fuel and the new fuel that has been bred can then be reprocessed and re-fabricated into new fuel elements right in the EBR II facility.

Electrodyne is an integral part of the EBR II design controlling the hold-down mechanism for the cover of the fuel chamber which will be submerged in liquid sodium. This reactor has been planned to demon-

strate the "breeding principle" that more fuel (plutonium) can be bred from uranium-238 than is used up while the reactor is operating. EBR II has been designed to produce usable electricity from atomic energy.

For customer applications, *Electrodyne* thrust limiting features assure positive, automatic control and complete safety in the handling of the most critical materials.

This again illustrates the versatility of *Electrodyne* as a valve-type control for a wide variety of applications in chemical and power plants, oil and gas industries and water and waste treatment installations.

For detailed information about *Electrodyne*, get in touch with your local *Electrodyne* representative or any valve manufacturer.

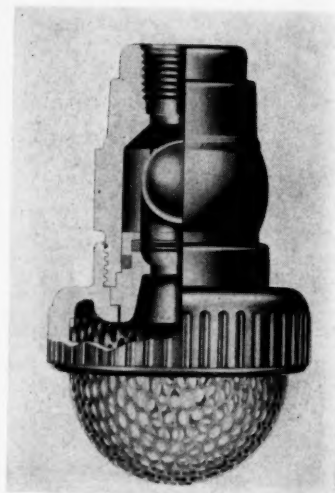
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ELECTRODYNE VALVE CONTROLS . . . HYDROID GEAR PUMPS AND MOTORS . . . PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE GEARING AND COMPONENTS

NEW EQUIPMENT . . .

sizes from 1 to 200 hp., and with special models, up to 500 hp.—Philadelphia Gear Corp., Philadelphia, Pa. 149A



Foot Valve

All-plastic item available for sump service.

Designed for use in sumps, tanks, etc., where fluid level must be lowered, Chemtrol's new plastic foot valve is completely inert to corrosive influence. A ball check valve prevents backflow, and a large, hemispherical plastic screen completely protects the suction end against intake of debris.

Size range varies from $\frac{1}{2}$ through 2 in. Material of construction can be either Type I or II polyvinyl chloride. Connectors are offered with threads or with standard socket dimensions for solvent welding.—Chemtrol, Lynwood, Calif. 150A

Mixing Machine

Holds promise of new process efficiency, economy.

Mistifier, a versatile new processing tool, may offer advantages well worth investigation for processes involving mixing, blending, extracting, size reduction or reaction of materials. In operation, the machine converts liquid or

powder feeds, singly or in combination, to a fine mist. While particles are in the process of size reduction, they are repeatedly thrown in violent contact with one another, speeding up both physical and chemical action.

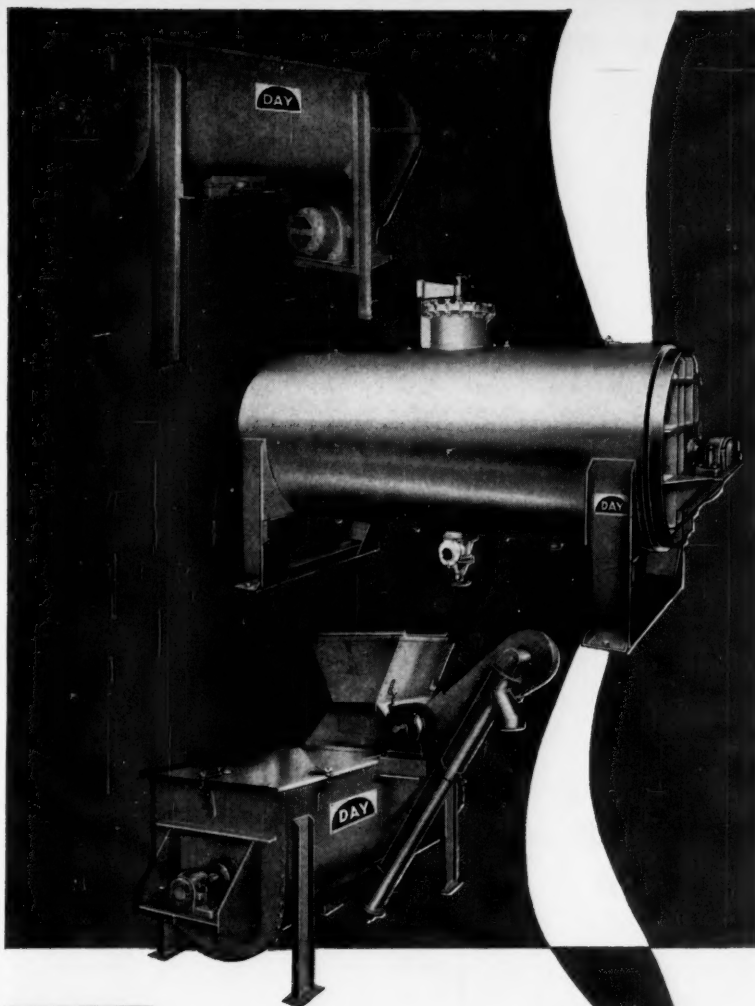
Says the manufacturer, many materials can be mixed as readily and thoroughly as gases, and at a fraction of former cost. Temperature, atmosphere and pressure within the mixing chamber are subject to close control. As yet, Mistifiers have not been standardized; they are currently available only as custom items. Essentially, the working components are a rapidly spinning rotor and an opposing stator, both having irregular, stepped surfaces. Maximum rotor speed is 15,000 rpm.—R. J. Lamb, Jersey City, N. J. 150B

BRIEFS

Ball valves for installation in close quarters test out to 1,000 psi. in sizes $\frac{1}{4}$ to $\frac{3}{4}$ in., and to 600 psi. in sizes 1 through 2 in. Useful temperature range is -300 to 400 F. Available now in stainless and carbon steel, the valves will be shortly offered in plastic and brass. ASA dimensions.—Cooper Alloy Corp., Hillside, N. J. 151A

Finned heaters, developed for bulk storage tanks, help overcome corrosion problems confronting plants that must use poor-quality steam. Made of carbon steel or various alloys, each heater has 295 sq. ft. heating surface. Pressure rating is 600 psi. at 650 F. Fintubes are $1\frac{1}{2}$ -in. Schedule 80 seamless pipe.—Brown Fintube, Elyria, Ohio. 151B

Data logger for measurement of fluids in tanks at given temperatures, sets off audible or visual alarms at predetermined limits. Data is delivered continuously on typed or punched tape records. Modular in construction, Type No. 3 loggers are 48 x 24 x 24 in., and come complete with top-mounted typewriter.—



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to meet all your needs - - -

for perfect blending of powders, pastes or liquids. DAY builds ribbon blenders having rugged tanks of many designs, in a variety of materials . . . with powerful drives . . . and various types of agitators . . . in capacities that range from $7\frac{1}{2}$ to 3850 gallons. Often combined with such allied DAY equipment as Ro-Ball or Brush Sifters that save floor space and increase your efficiency. Whatever your mixing requirements, there's no better buy than a low cost, trouble-free DAY Ribbon Blender!

The J. H. DAY Co.

Division of The Cleveland Automatic Machine Co.

4926 Beech Street, Cincinnati 12, Ohio

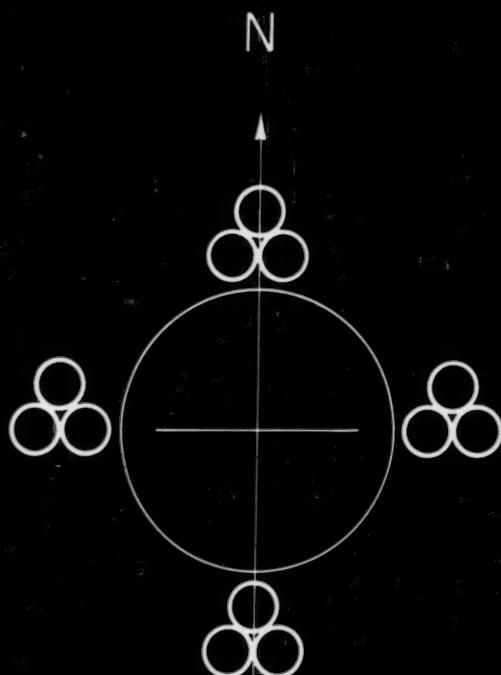
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NEW EQUIPMENT . . .

Hanson-Gorrill-Brian, Inc.,
Glen Cove, N. Y. 151C

Shell-and-tube heat exchangers made of Pyrex-brand glass have a heat transfer area of 60 sq. ft. Engineered for cooling operations, the exchangers can take operating temperatures to 200 F. on the shell side, 375 F. on the tube side. Maximum working pressure is 20 psi. In water-to-water tests, over-all transfer coefficients ran about 213 Btu./(hr.) (sq.ft.) (deg. F.). Standard units have a steel shell.—**Corning Glass Works,** Corning, N. Y. 152A

Indicating controller for temperature features a 12-in. circular readout based on a rugged, null-balance servo system. Temperature control is maintained electronically, without depending on meter movement for initiation. Available with either time proportioning or on-off control, the instrument has an indication accuracy of $\pm 1\%$ scale range.—**Electronic Processes Corp.,** San Francisco, Calif. 152B

Equipment Cost Indexes . . .

	June 1959	Sept. 1959
Industry		
Avg. of all.....	234.3	235.8

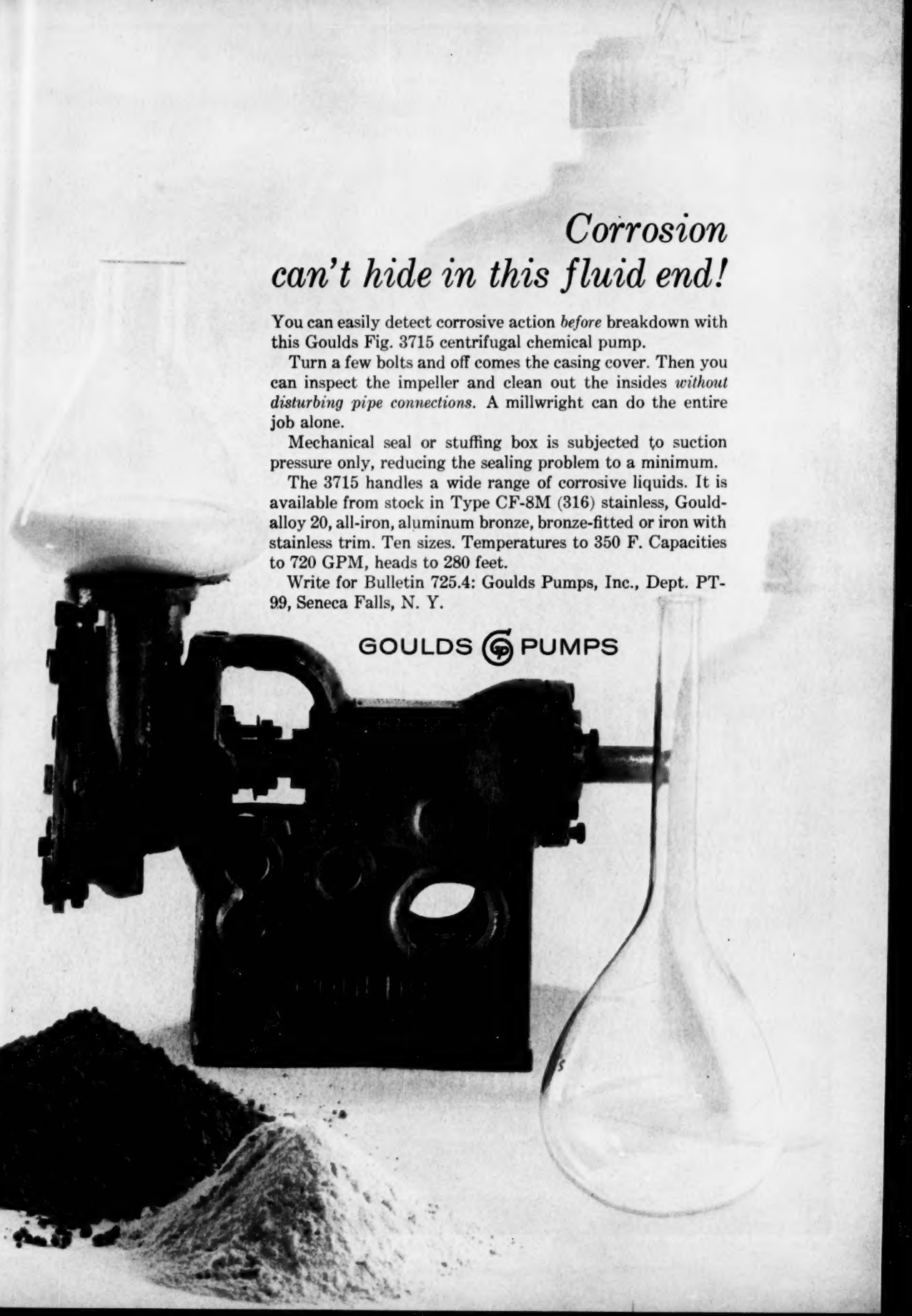
Process Industries

Cement mfg.	227.9	229.9
Chemical	235.7	237.5
Clay products	221.5	223.4
Glass mfg.	222.5	224.2
Paint mfg.	226.6	228.0
Paper mfg.	227.1	228.8
Petroleum ind.	231.4	232.9
Rubber ind.	234.0	235.7
Process ind. avg....	232.8	234.1

Related Industries

Elec. power equip....	246.7	239.4
Mining, milling	237.1	239.0
Refrigerating	264.7	266.4
Steam power	221.8	223.2

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



Corrosion can't hide in this fluid end!

You can easily detect corrosive action *before* breakdown with this Goulds Fig. 3715 centrifugal chemical pump.

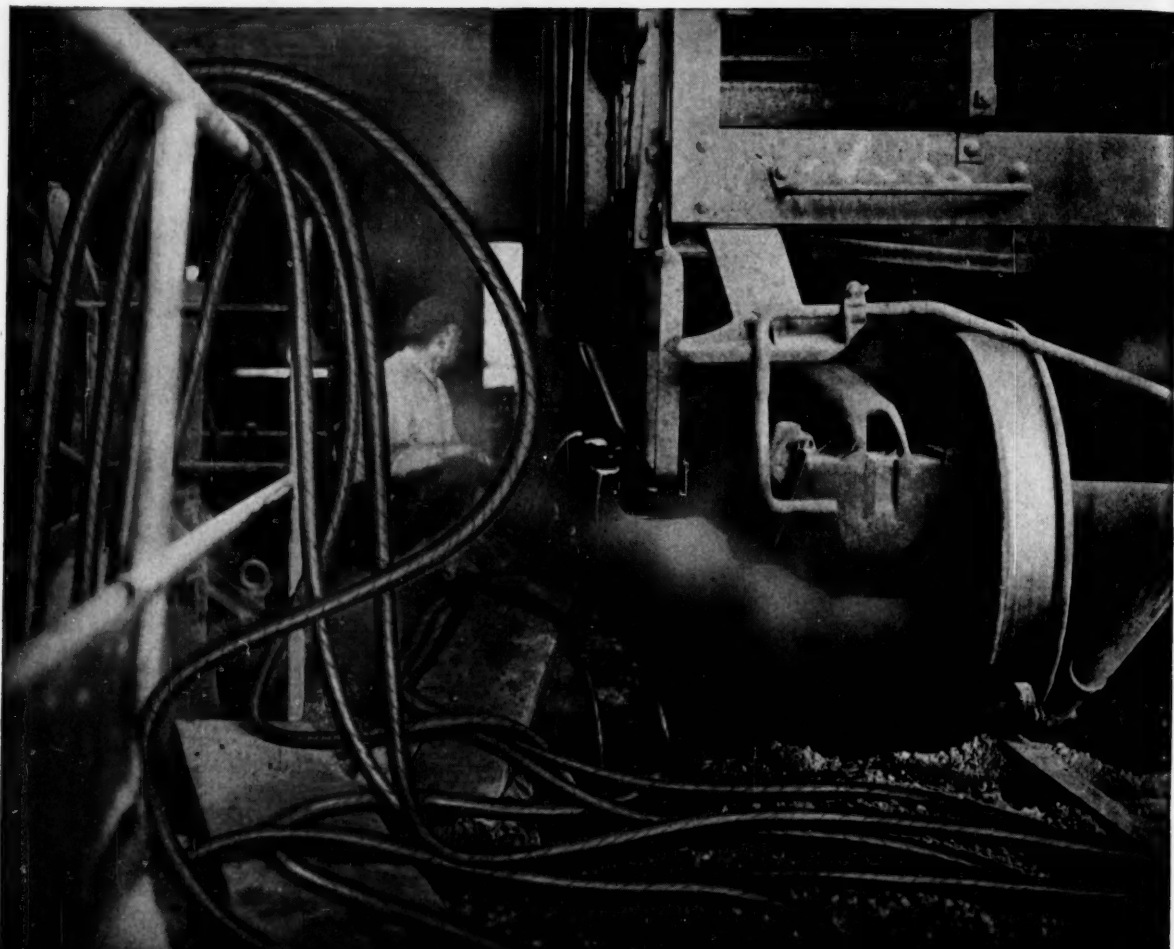
Turn a few bolts and off comes the casing cover. Then you can inspect the impeller and clean out the insides *without disturbing pipe connections*. A millwright can do the entire job alone.

Mechanical seal or stuffing box is subjected to suction pressure only, reducing the sealing problem to a minimum.

The 3715 handles a wide range of corrosive liquids. It is available from stock in Type CF-8M (316) stainless, Gould-alloy 20, all-iron, aluminum bronze, bronze-fitted or iron with stainless trim. Ten sizes. Temperatures to 350 F. Capacities to 720 GPM, heads to 280 feet.

Write for Bulletin 725.4: Goulds Pumps, Inc., Dept. PT-99, Seneca Falls, N. Y.

GOULDS  PUMPS



This plant turns on the steam to break loose frozen coal

The faster the coal flows the less it costs. This calls for steam at high pressure, and calls for a high pressure steam hose that's burst-protected, flexible, easy to handle. Management decided on Acme-Hamilton's wire braided steam hose because it meets all requirements and can be used for all steam applications safely and economically.

- (A) Cover. Heat, abrasion, oil, sunlight and weather resistant.
- (B) Carcass. 1 or 2 braids of high tensile wire. Prevents bursting, yet is very flexible.
- (C) Tube. Handles saturated steam to 385° F., 200 lbs. working pressure. Won't loosen, soften or flake. Write Dept. M91.

Acme Hamilton

MANUFACTURING CORPORATION, TRENTON 3, N. J.

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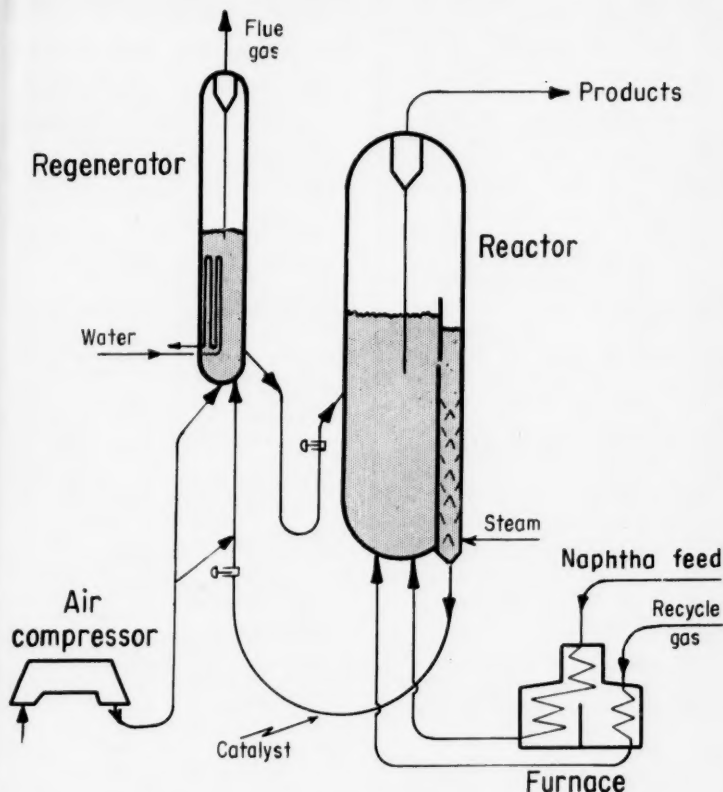
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PEOPLE . . .

TECHNICAL BOOKSHELF

J. B. BACON



Fluidization took on Hydroforming (above) in early '50's.

Fluidization: A Roundup

FLUIDIZATION. By Max Leva. McGraw-Hill Book Co., New York. 336 pages. \$11.50.

Reviewed by W. Glass, Esso Research & Engineering Co., Linden, N. J.

This book represents an excellent critical compilation of the large amount of published laboratory data dealing with the mechanics of fluidization. The thorough coverage of foreign publications is particularly noteworthy.

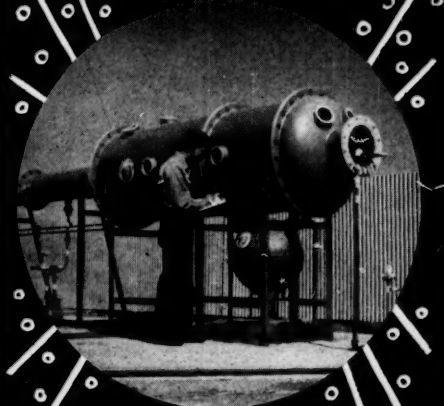
Handy working correlations are presented for predicting such

phenomena as the onset of fluidization and fluid bed expansion. Similar correlations for heat and mass transfer should also be useful.

However, a more detailed presentation of what might be called the fundamental problem in fluidized reactor design would have been desirable. The engineer or student designing or evaluating a fluid bed as a possible chemical reactor system has to determine the fluidized reactor size and shape necessary to achieve a given amount of reaction. He will most likely have available a reaction rate equation either in

SOLVE

tough
separation
problems



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specialized
peerless
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When it comes to liquid vapor separators and wet and dry-type dust scrubbers or gas filters you can depend on Peerless engineering "know how" and equipment, used the world over.

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Take Guesswork Out of Lab Crushing & Grinding

Sturtevant Design Provides Easy Access for Cleanouts — Returns Complete Sample

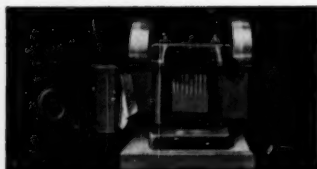
In seconds, because of "Open-Door" accessibility, all Sturtevant crushing or grinding parts are exposed for thorough cleanouts. 100% sample return is easy to secure.

Sturtevant laboratory machines are ruggedly constructed — design, based on production models, gives top lab or pilot performance.

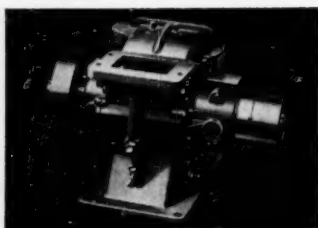
Send for Bulletin No.067, which gives full description of all Sturtevant laboratory machines.



Lab Crushing Rolls: Special lab design. Two models: 8 x 5 in. and 12 x 12 in. rolls. Capacities to 10 tph. Both models adjust down to 20 mesh. Tires of high carbon forgings. Automatic feeder, adjustable controls.



Lab Jaw Crusher: Crushes hardest rocks at 1/2 to 3/4 in. settings. Roll jaw action — no clogging. Feed opening 2 x 6 in. Capacity to 1900 lbs. per hr. at 1/2 in. setting. Instant adjustment. Manganese jaws, reversible shield.



Lab Swing-Sledge Mill: 5 x 6 in. opening takes soft, medium, tough or fibrous feed. Capacity to 1 tph. Fines regulate from 1 in. to 20 mesh. Choice of gratings, hammers (or knives).



Sample Grinder: Disc type grinders for dry, friable soft or medium materials. Three sizes — 6 in., 10 in., and 14 in. take feed as coarse as 1/4 in. Produces 100 mesh fines at capacities to 200 lbs. per hr. on largest model. Regulate 10 to 100 mesh. In-operation adjustment.

STURTEVANT MILL COMPANY

100 Clayton St., Boston 22, Mass.

BOOKSHELF . . .

differential form for a point condition, or in an integrated form for some known flow pattern such as, for example, piston flow. The engineer must be able to integrate the rate equation for the flow pattern expected in the fluidized reactor. To help him do this, he needs guidance as to what the flow patterns are likely to be—what simplifying assumptions are likely to be justified—what flow "models" have been successful in the past.

This book does not present much guidance in these areas. It is unfortunate that material from some of the papers given at the 1957 AIChE Chicago fluidization symposium was not included.

The contents of this book are presented in a very readable manner. A commendable feature is the inclusion of an abstract and summary for each chapter. The problems at the end of each chapter seem well coordinated with the material covered. The book should prove a very useful addition to the reference shelf.

Organic Syntheses

ORGANIC SYNTHESIS, Vol. 39. Edited by Max Tishler. John Wiley & Sons, Inc., New York. 114 pages. \$4.

Reviewed by J. Richard Mayer, Sterling-Winthrop Research Institute, Rensselaer, New York.

Volume 39 of "Organic Syntheses," edited by Max Tishler, adds to the organic chemist's library a valuable source of synthetic organic procedures. Included among the syntheses of 28 compounds are such interesting and potentially useful ones as p-dithiane, indole-3-aldehyde, methyl cyclopentane carboxylate, methylene cyclohexane, 1-phenyl-1-peten-4-yn-3-ol, 2,4,4-trimethyl cyclopentanone, and triptycene.

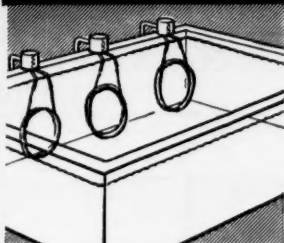
The present volume, similar to previous volumes, contains detailed preparative directions, which have been independently checked, corresponding to optimum yields for each synthesis, the physical properties and possible hazards of the products, special notes on procedure and reagents.



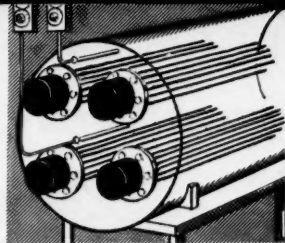
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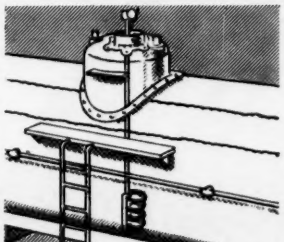
Call your **CHROMALOX** Man for heating answers



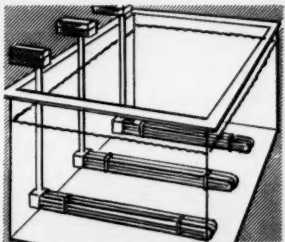
For plating applications, Chromalox CT Immersion Heaters are sheathed in lead, copper, stainless steel.



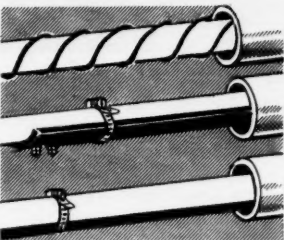
Water heating with TM flange-type Immersion Heaters mounted at one end of a tank.



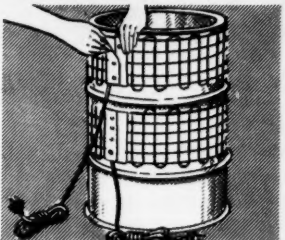
Heating viscous materials with BLCK Immersion Heaters before pumping from a railroad tank car.



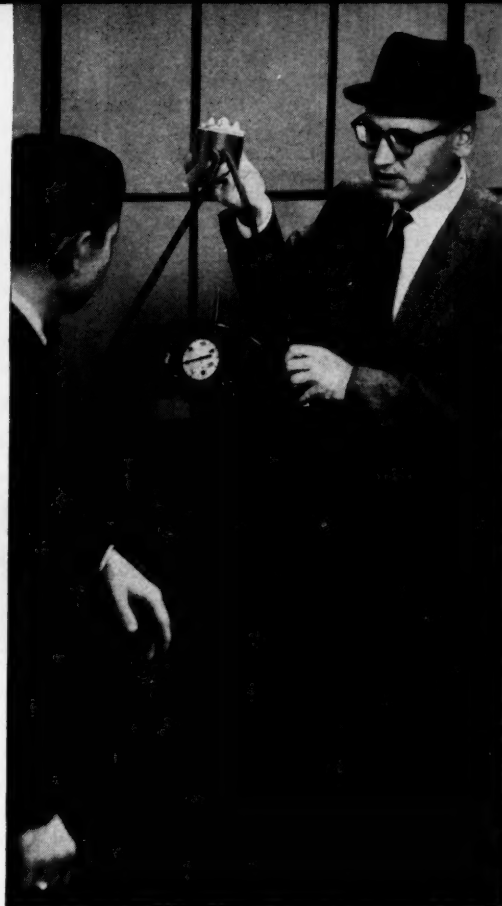
Heating liquid held at constant level. TL Heaters generate heat parallel to the tank bottom.



Pipe heating with Chromalox Thermowire (300°F), Strip Heater (750°F) and Tubular Heater (1100°F).



Heat for 5- and 55-gallon drums. Just snap on and plug in. Protective coating resists abrasion, chemicals.



LIQUIDS? Only **CHROMALOX** heats so many things . . . so many ways

There's one best way to do any job. And you get the best results only by using that one best method.

Regardless of what your heating problems may be . . . your best chance of finding the best answer is to call your Chromalox Man.

- He represents more than 15,000 different types, sizes and ratings of electric heaters and heating elements . . . the world's largest line.
- He orders from the world's largest stock.
- And he is a *heating expert* . . . he understands your problem and can help you find the answer.

Maybe Chromalox Strip Heaters are the answer. They quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens, air ducts. Or maybe Chromalox Tubular Heaters. They clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Chromalox Cartridge Heaters smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Many other types of Chromalox heaters do many other jobs.

No matter what your heating problem is . . . solids, liquids or gases . . . call your Chromalox Man for the efficient, *electrical* answer. (*His name and phone number are listed at the left.*) Or, check the boxes below, write your name, title, and address at the bottom of this page and mail it to us. Edwin L. Wiegand Company, 7500 Thomas Boulevard, Pittsburgh 8, Pa.

- ☐ Send me Catalog 60
(General Industrial heating applications).
- ☐ Send me specific information on the heating problems I have outlined on the sheet attached.
- ☐ Have a Chromalox Representative contact me.
- ☐ Do not have a Chromalox Representative contact me.

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Manning & Lewis engineers have developed a wide range of standardized heat exchangers that fulfill nearly all normal requirements. Selection and use of these standardized heat exchangers will save engineers valuable time, assure an economical purchase price and expedite delivery time. Investigate these and other benefits of standardized equipment by M&L, long a recognized name for quality. Write on your company letterhead for bulletin.

In addition, a new four-color bulletin describes and illustrates the complete M&L line. Specify Bulletin 820 in your request.

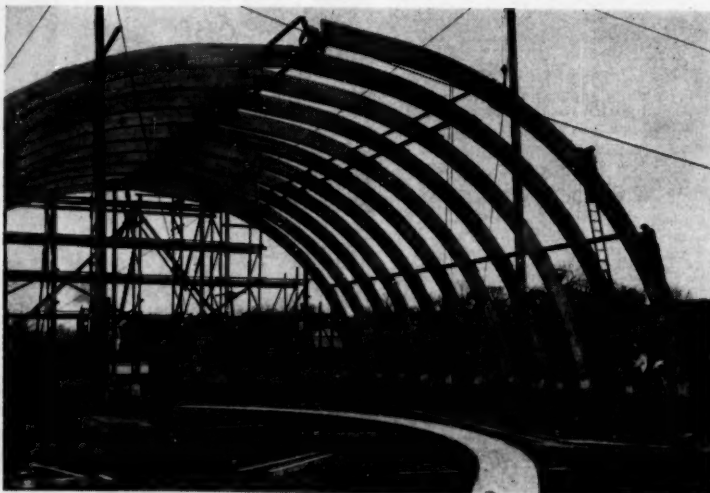


MANNING & LEWIS
Engineering Co.

Dept A, Ogden Street, Newark, N. J.

LETTERS: PRO & CON

C. H. CHILTON



Pro: "Noncombustible" Wood Sir:

It is most gratifying to see a publication of your stature take such a close look at the many new developments in noncombustible wood. The article in your Nov. 16 issue (pp. 216-220) was most informative and certainly merits wide distribution to industry.

The article does contain one point of inconsistency. Under "Limitations," you accurately point out that fire-retardant chemicals are water-soluble and not recommended for outdoor use. But in the first paragraph on p. 218 you suggest that fire-protected wood will go into cooling towers and filter frames. This is obviously an oversight.

PAUL A. SCHWEIBINZ
Koppers Co.
Pittsburgh, Pa.

Sir:

The section headed "Wooden Warehouse" on p. 220 is something less than exact.

Your statement that fire in a burning building can raise temperatures to 1,300 F. is true. But it is equally true that fire in a burning building can raise temperatures to more than 2,000 F. The implication that 1,300 F. may be considered a top limit applies only to the specific building described, since the aluminum

siding and roofing would melt at about this temperature and prevent any additional heat buildup.

W. H. DOYLE
Factory Insurance Assn.
Hartford, Conn.

Bouquets for "Parm"

Sir:

As a former member of the editorial staff, I wish to say a few words about Howard C. Parmelee.

"Parm," as he was affectionately known by many, was one of the great editors of his time. He stood for the principle that editorial quality is the essential basis of value to the advertiser as well as to the reader.

In an age when "puffs" were widely accepted in trade for advertising space, and editorial policies were often dictated by the business office, Parm and his publisher (the late James H. McGraw) would have none of such deals. If an advertiser cancelled, he was offered no appeasement, which made him madder than ever. (But after an interval, the space usually was reinstated.)

When *Chem. & Met.*'s Silver Anniversary issue was published in 1927, the lead editorial was headed, "Twenty-Five Years of

Filters and their Fabric requirements

Experienced engineers recognize that in filtration the varying requirements of pressure, vacuum and gravity filters necessarily affect the type of filter cloth to be used.

In pressure filtration, the slurry is forced through the filter medium under pressure, with the obvious implication that the filter fabric must have adequate mechanical strength and durability to withstand the force.

The plate and frame press, probably the most universally used, demands particularly tough fabrics. Because the filter chambers are formed by alternate plates and frames, the filter cloth must have adequate gasketing properties. Scraping off of the filter cake when the press is opened is a severe test of the filter cloth, and is a compelling reason for abrasion resistance.

Fabrics for recessed-plate pressure filters, in which intervening frames are not present, require exceptionally high flex and abrasion resistance because the cloth must be tightly bolted to angular plate surfaces.

Vacuum drum filters can generally employ lighter weight fabrics than pressure filters. Dimensional stability, however, is necessary to prevent cloth from pulling away from drum edges, or from ripping under the strain of shrinkage around the circumference.

While gravity filters use media of various types, cloth may often be the answer.

To get complete information about filter fabrics, make sure you consult a specialist. The specialists who distribute Wellington Sears filter fabrics are fully equipped to help you select the medium that best answers your problems. Behind them, they have our 114 years of experience in providing quality fabrics to industry. For distributors' names, and a handy information booklet, "Filter Fabric Facts," write Dept. L-1.



Wellington Sears Company **FIRST In Fabrics For Industry**

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precise mixing
results with
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Eastern Portable Mixers are especially designed for dependable, low cost service in small batch processes. Where fixed mounted installations are not required, Eastern's Portables offer greater versatility, ease of handling, and long term cost savings.

Speeds of 420, 1125, and 1725 R.P.M. rated from 1/20 to 3 H.P. are standard, with variable speed and air-driven models also available. Motors in all standard types can be supplied in semi-enclosed, totally-enclosed, or explosion-proof construction. Shafts and single or dual propellers are available in a choice of alloys for all service requirements. New optional ball-swivel clamp as illustrated, permits easy adjustment of mixer position in tank.

For a personalized analysis of your mixing problems, send details to Eastern engineers. A recommended solution will be furnished promptly and without obligation. For a helpful guide to mixing fundamentals, write for "Handbook of Fluid Mixing."

NEW PORTABLE MIXER BULLETIN

Eastern's improved line is included in the revised Portable Bulletin No. 530-B.

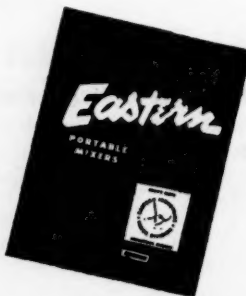


Eastern



INDUSTRIES, INC.
MIXER DIVISION

Regent Street
East Norwalk, Conn.



PRO & CON . . .

Militant Journalism." Now as then, the words "militant journalist" seem fittingly descriptive of the man who wrote them.

Yet Howard Parmelee was not a severe, unbending person. His humor was legendary. Once, after a particularly sharp verbal exchange with an irate subscriber, Parm remarked dryly, "An editor may not always be right, but he can have the last word."

CHAPLIN TYLER

E. I. du Pont de Nemours & Co.
Wilmington, Del.

Sir:

Parm gave all of us who worked under him a lot that has become a part of us. I hope he had the satisfaction of recognizing that there are a lot of guys still around who are better for having known him.

A. E. BUCHANAN, JR.

E. I. du Pont de Nemours & Co.
Wilmington, Del.

Con: Nonexistent Gases

Sir:

Your feature report for Nov. 2, "How to Receive and Unload Liquefied Compressed Gases," was a thorough, informative and interesting review. The Compressed Gas Assn. committee is to be commended for its work.

As manufacturers of fluorinated refrigerants, we quickly noted two typographical errors on p. 97. Neither dichlorotetrafluoromethane nor trichlorotrifluoromethane exists, but the corresponding ethane derivatives are the commercial refrigerants you undoubtedly meant.

JAMES A. CONOVER

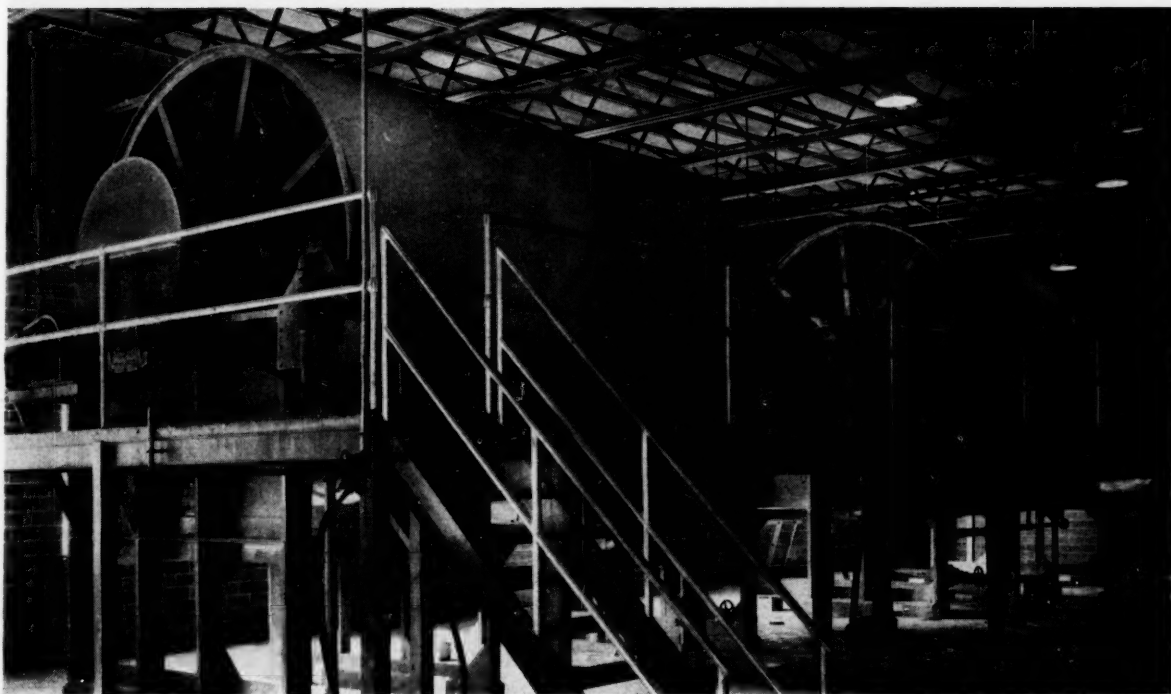
Pennsalt Chemicals Corp.
Calvert City, Ky.

Con: Misrepresentation

Sir:

Having long admired the work of Donald Q. Kern, it is with regret that I find him misrepresenting some work of mine (*Chem. Eng. Science*, 7, 166, 1958) in his recent article in your journal (Oct. 5, pp. 127-142).

The subhead of this article



FEinc Rotary Vacuum String Discharge Filters
at The Hubinger Company, Keokuk, Iowa.

FOR THE HUBINGER COMPANY . . .

STRING DISCHARGE FILTERS *solved the problem*

These FEinc rotary vacuum filters were recently custom built to specifications for The Hubinger Company, Keokuk, Iowa. The job they're doing is a tough one . . . filtering gluten derived from the wet milling of corn.

The string discharge design was selected as the only workable method for cleanly removing the thin, high-protein gluten cake which causes scraper filters to bog down. Each unit has over 500 square feet of filter area.

LOW MOISTURE CAKE CONTENT

Operating continuously, these string discharge filters eliminate blow-back and produce a cake

of low moisture content. Stainless steel construction helps maintain product purity according to standards established in over 75 years of starch production.

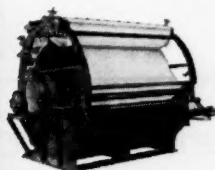
The FEinc filters in this installation are examples of how custom-made units provide solutions to many difficult continuous filtration problems in the chemical processing industry.

For help with your problem, see our insert in Chemical Engineering Catalog or write today, Dept. CEF-160, for free bulletins and technical advice. Simply state your basic requirements.

For a
Bigger Yield

FE INC.

FILTRATION ENGINEERS
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS



STRING



HORIZONTAL



SCRAPER

CUSTOM DESIGNED CONTINUOUS FILTRATION

Steady filtration FULLY AUTOMATED

NIAGARA Filters are available in completely automated models for production-line filtration. Operating with process streams from 5 to over 1,000 gallons per minute, these highly efficient, versatile filters adapt easily to automatic processing of many materials like these:



Speedy cake removal, elimination of manual cloth washing and totally enclosed construction are NIAGARA advantages which are helping save time and improve product quality in all areas of the processing industry. For more complete data, see the NIAGARA section in Chemical Engineering Catalog or write:

Niagara® FILTERS
A DIVISION OF
American Machine and Metals, Inc.

Dept. CEN-160, EAST MOLINE, ILLINOIS

(Niagara Filters Europe: Kwakelpaad 28, Alkmaar, Holland)
Specialists in liquid-solids separation

PRO & CON . . .

urges us to "abandon precision as an early objective." Dr. Kern's comments on my work seemed guided by this principle.

It is unlikely that everyone who read the article will also read this letter. It is thus impossible to completely erase any erroneous impressions resulting from Dr. Kern's misguided comments.

A. H. P. SKELLAND
Illinois Institute of Technology
Chicago, Ill.

Head Areas Corrected

Sir:

In your Apr. 6, 1959, Process Design Notebook you published a contribution of mine entitled "Formulas for Formed Head Characteristics." I have just discovered an error I made in this.

The formulas I gave for area of head A, in which OD appears to the second power, should have been for blank diameter BD of the plate from which the head is made, with OD to the first power. Area A then is $0.785(BD)^2$. Here are the correct equations:

For standard flanged and dished heads,

$$BD = 1.05(OD)$$

$$A = 0.87(OD)^2$$

For ASME flanged and dished heads,

$$BD = 1.08(OD)$$

$$A = 0.92(OD)^2$$

For ellipsoidal heads,

$$BD = 1.23(ID)$$

$$A = 1.19(ID)^2$$

P. V. FOLCHI

Consulting Engineer
Cincinnati, Ohio

Solution Mining Patents

Sir:

Your July 13, 1959, issue contained an article (pp. 147-8) entitled "Engineering the Two-Well Method of Solution Mining," by J. K. Henderson.

We wish to call your attention to the fact that the mining method described by Mr. Henderson has been patented, and that patents are pending on improvements and other features of the methods. The issued patent, U. S. 2,847,202, granted to M. W. Pullen on Aug. 12, 1958, and

other pending patent applications have been assigned to Food Machinery & Chemical Corp.

Food Machinery will negotiate license agreements under these patents with anyone interested in using this new technique for mining salt.

MILTON ZUCKER
Food Machinery & Chemical
Corp.
New York, N. Y.

They Didn't Notice

Sir:

Frequently I cut articles out of *Chemical Engineering*. Using a pen knife, I end up with a ragged edge. Why don't you perforate your pages?

W. P. GREGORY
Adolph Coors Co.
Golden, Colo.

Sir:

Articles of special interest and value are frequently saved from almost every issue of *Chemical Engineering* by many of its readers, including myself. If the pages were perforated near the binding they could be easily and neatly removed and saved. May I look forward to this improvement in your magazine?

THOMAS M. O'GRADY
Standard Oil Co.
Whiting, Ind.

► These two recent letters indicate that some of you have been missing the advantages of our new type of binding, used for every issue since last June. We announced it on the contents page of our June 15 issue and explained what it meant to you who clip and file articles.

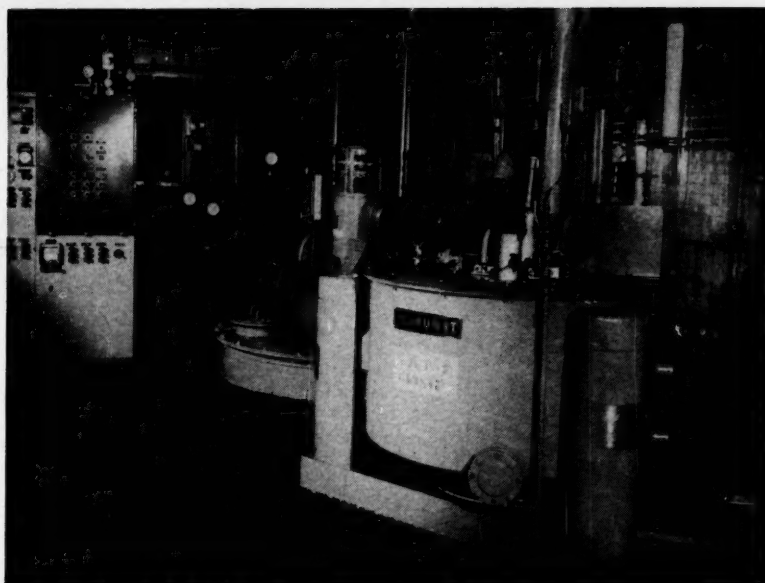
Our new binding doesn't use staples. Instead, it uses a special adhesive which provides two desirable objectives:

- The magazine opens flat, making it easier for you to use at your desk.

- Pages are easily removed intact, with no knife, razor blade or thread. Open the magazine to the article you want, press it flat, hold it down with one hand while you gently pull out the pages you want.

Perforated pages, while providing these advantages, have two points against them. They do not have the strength needed for permanent binding into reference volumes, and the loose pages usually have too small a margin for loose-leaf binders.

Many of our readers have already commented favorably on our improved type of binding.—ED.



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This completely automated Tolhurst BATCH-O-MATIC meets this user's requirements for a dual-purpose extractor.

In the first application, excellent recovery of filtrate is obtained and solids are discarded.

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BATCH-O-MATIC operation reduces exposure time and, therefore, maintains product stability.

Automatic operation, no crystal degradation during unloading, stepless variable basket speed, trouble-free performance and low operating costs helped determine the selection of a BATCH-O-MATIC. For more complete data, see the Tolhurst section in *Chemical Engineering Catalog* or write. Address Dept. CET-160, East Moline, Illinois.

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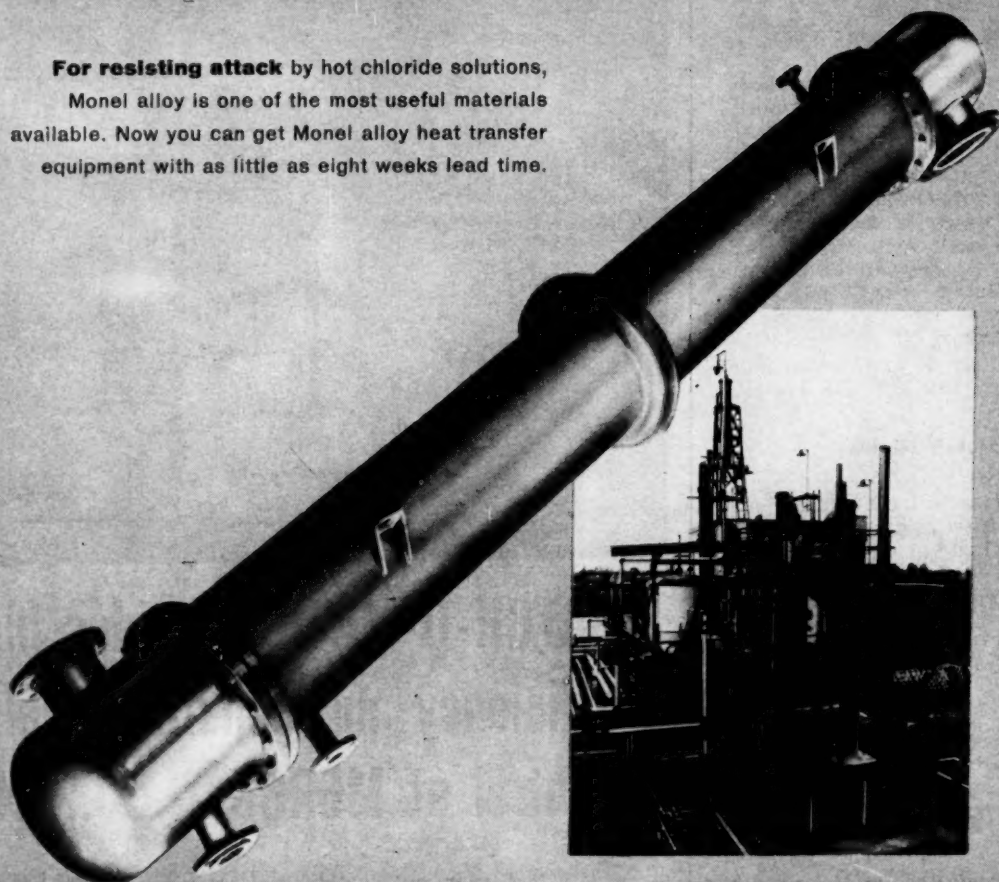
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EAST MOLINE, ILLINOIS

For resisting attack by hot chloride solutions, Monel alloy is one of the most useful materials available. Now you can get Monel alloy heat transfer equipment with as little as eight weeks lead time.



How Monel alloy protects this reflux condenser against hot chloride corrosion

In producing gasoline additives, Socony Paint Products Company* must handle a process stream containing phosphorus oxychloride and hydrogen chloride ... at temperatures up to 410° F.

These corrosives can be hard on equipment. General attack, pitting, and stress corrosion cracking rapidly destroy many common materials.

But Monel** nickel-copper alloy is specially suited for handling hot chlorides. Monel alloy offers a unique combination of useful properties — corrosion resistance, ease of fabrication, plus the strength of structural steel.

**Fast delivery of standard
Monel alloy heat transfer equipment!**
Doyle & Roth Manufacturing Company

of Brooklyn, New York has standardized designs for heat transfer equipment, and stocks basic parts. "Pulls them right off the shelf," assembles and ships. When Monel alloy is specified, units are normally delivered in less than eight weeks. Just as the Socony condenser was.

Equipment meets TEMA requirements and ASME code. It may be specified within the following parameters: 6 to 20 foot lengths, 20 to 1500 sq. ft. surface areas, 75 to 300 psi shell and tube side pressures.

To get complete details

... about Doyle & Roth standard Monel alloy heat transfer equipment, write that company at 136-50 24th Street, Brooklyn 32, New York.

... about materials to hold hard-to-handle corrosives, contact us. Our engineers will gladly provide the metallurgical information you want.

... about handling severely-corrosive hot acids and oxidizing chemicals. Here's a technical booklet on recently-developed Ni-o-nel** alloy that may provide an easy answer. Ni-o-nel alloy resists attack by sulfuric, phosphoric, and nitric acids over a wide temperature and concentration range. For details, write for a free copy of "Engineering Properties of NI-O-NEL."

*Socony Paint Products Company, Metuchen, New Jersey
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51a—Sulfonate derivatives

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holds temperatures to close limits in entire processing column

● This Niagara "Aero" Vapor Condenser produces constant temperatures, assures sustained capacity to this fractionating column, holding production and quality uniform. A closed system, it avoids fouling troubles, holds temperatures within specified limits at all points.

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NIAGARA BLOWER COMPANY

Dept. CE-1, 405 Lexington Avenue
NEW YORK 17, N. Y.

District Engineers in Principal Cities

READER SERVICE...

TECHNICAL LITERATURE

E. M. FLYNN

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Chemicals

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138A Rohn & Haas Co.

Acrylonitrile.....5 p. Technical Bulletin 3-1 tell why company's Chem-pump leakproof "canned" pumps are particularly suited to handling acetylene chemicals.
168B Fostoria Corp.

Adhesives.....New list of approved non-toxic adhesives for food packaging use includes a series of resin based emulsion glues for convolute & spiral-wound containers.
168C Borden Chemical Co.

Agricultural Chemicals.....40 p. booklet covers products of company's farm chemical & insecticide division. Covers applications, research facilities.
168D S. B. Penick & Co.

Alkyd Resins.....6 p. bulletin 4 contains data for the alkyd formulator on the use of company's polyether acid N-1 in alkyd resin formulation. Includes test data.
168E S. C. Johnson & Son

Amino-Acid Resins.....Series of ion-exchange resins for separation & analysis are available in 2 types for use with fraction collectors or amino-acid analyzers.
33-34f *U. S. Industrial Chem. Co.

Antioxidant 425.....works ceaselessly to protect clean, white, strong rubber thread. Antioxidant 425 also assures the ultimate in long-lasting whiteness. Information.
6-7a *American Cyanamid Co.

Carbon-14.....46 p. illustrated catalog lists carbon-14 labeled compounds available. Gives ordering and licensing information, purity methods and other data.
168F Research Specialties Co.

* From advertisement, this issue

Caustic Soda.....Specifications, properties, applications & shipping information for caustic soda are detailed in a new data sheet which is now available.
33-34b *U. S. Industrial Chem. Co.

Chemical.....Tetramethylguanidine (TMG) is a liquid with a slight amoniacal odor. It boils at 159-160 C & is soluble both in water and organic solvents. Information.
6-7d *American Cyanamid Co.

Chemicals.....Portfolio contains 6 p. folder on facilities for custom chemical synthesis, collections of data sheets on production chemicals and on development chemicals.
168G Eli Lilly & Co.

Chemicals.....The Marasperse dispersants are low-cost, effective, anionic surfactants, derived from highly purified lignosulfonates. Bulletin 125.

172 *Marathon, Div. American Can Co.

Chemicals.....for cleaning process equipment without dismantling, scraping, rodding, sandblasting ... without lengthy off-stream breaks in production. Tech. Lit.
178 *Oakite Products, Inc.

Colloidal Silicas.....Properties and characteristics of Nalcoag colloidal silicas are described in Bulletin K5, which is now available on your request.
137 *Nalco Chem. Co.

Color Concentrates.....Folder on epoxy resin color concentrates describes line available to user to perform his own coloring or in already colored liquid systems.
168H Resinform Formulators, Inc.

Dyes.....Complete information on Calcofluor is now available on request. Provides white brightener to paper and board stock.

6-7b *American Cyanamid Company
Dyes Department

Epoxy Resin.....20 p. bulletin K-2967, "Kopoxite 159 Resorcinol Diglycidyl Ether (RDGE)," introduces a new resorcinol-based resin which permits wide choice of curing conditions.
168I Koppers Co.

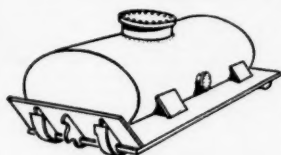
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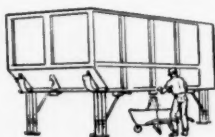
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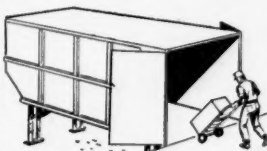
TANK CONTAINERS



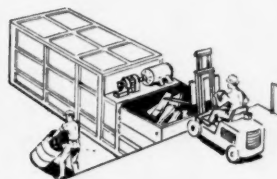
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VAN TYPE



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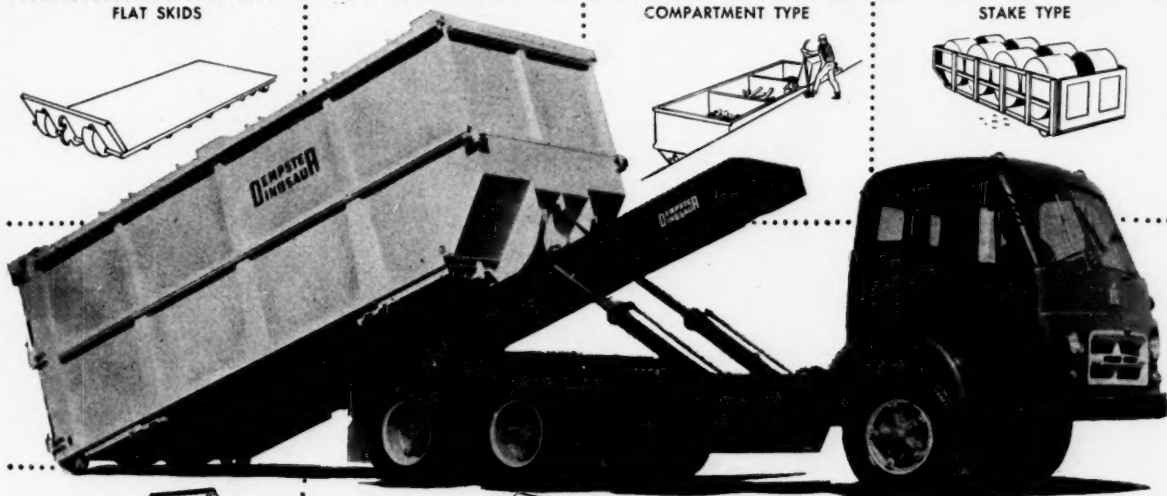
FLAT SKIDS



COMPARTMENT TYPE



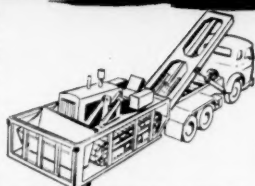
STAKE TYPE



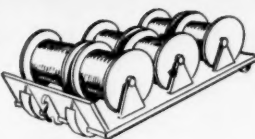
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HEAVY EQUIPMENT CARRIERS



CABLE REEL MOUNTS



PORTABLE FIELD OFFICES



Patents Pending

Here's the materials handling tool that takes up where the fork-lift truck leaves off. Gigantic loads can be placed on skids, in tanks or containers. The **DEMPSTER-DINOSAUR** picks them up . . . automatically . . . in seconds . . . and whisks them to their destination, in-plant or to over-the-road locations. Here they are put down, intact . . . pushed off on a dock . . . left on telescopic legs . . . or dumped.

One truck handles any number of containers of many types. Value of truck is multiplied . . . standing-idle time is eliminated . . . loading and

handling is cut to the minimum. One man, the driver, handles the all-hydraulic operations without leaving the cab.

Containers available up to 40 cu. yds. and over . . . loads are limited only by the capacity of the truck. If you have a special problem send it in.

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DEMPSTER BROTHERS
Inc.

Knoxville 17, Tennessee, Dept. CE-1



To: **DEMPSTER BROTHERS, Dept. CE-1**
Knoxville 17, Tennessee

Please send free Dinosaur Brochure

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Firm _____

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on maintenance

Money Maker
on assembly...

Snap-on

Electric IMPACT WRENCH

You Handle All These Jobs FASTER...EASIER

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- Turn most pullers
- Drive and remove screws, lag bolts
- Remove and replace studs
- Remove carbon, scale, rust, paint
- Drill and ream holes
- Tap threads
- Many other jobs

This SNAP-ON electric impact wrench is one of the handiest tools in the shop. It works so fast and easy your men can turn out double and triple the work without even thinking about it.

There's extra safety, too, in an impact wrench. A man can get up on a ladder or work in awkward positions without fighting the side thrust of a regular electric tool. Also, on drill or other work it won't burn out if the attachment gets stuck.

The tool's one-half inch square drive takes sockets 3/8 to 1-1/16 in. — many accessory tools available. Two models — 115 volts, 220/230 volts. Tool is top quality throughout — has many construction advantages. Get full details from your SNAP-ON representative. Factory branch warehouses in principal industrial centers. Or write us.

SNAP-ON TOOLS
CORPORATION

8106-A 28th Avenue • Kenosha, Wisconsin

LITERATURE . . .

Flexible Lacquer.....for painting & decorating polyethylene has been developed. Said to be durable, chip-proof; will not come off with handling. No. 1555.
33-34k *U. S. Industrial Chem. Co.

Fluorocarbon Resins.....Piston rings made with Teflon resins cut replacement & maintenance costs. Details about fluorocarbon resins & how they can improve seals.
127 *E. I. du Pont de Nemours & Co.

Gasoline Additive.....22 p. bulletin on new Centrol S-41-K describes it as the economical gasoline additive designed for carburetor detergency, icing protection.
170A Central Soya Co.

Methionine.....New developments for cosmetic & pharmaceutical use were summarized & current applications were reviewed in paper given at TGA meeting.
33-34a *U. S. Industrial Chem. Co.

Molecular Sieves.....12 p. brochure describes uses of synthetic zeolites which contain cavities which can be pre-loaded with a chemical for release at a determined time.
170B Linde Co.

NaK and Potassium.....8 p. brochure covers chemistry, properties, and application including use as a heat exchange fluid in atomic reactors or high temperature processes.
170C MSA Research Corp.

Organometallic Compounds..... Two more are reported to behave like aromatics, although the compounds from which they are derived are completely nonaromatic.
33-34d *U. S. Industrial Chem. Co.

Reagents..... Booklet, "Thioacetamide as an Analytical Reagent," by H. F. Walton, discusses precipitation of metal sulfides from homogenous solution & reaction mechanism.
170D Arapahoe Chemicals, Inc.

Resin.....New Paper Product 2414-B, a water soluble polyacrylamide resin, is now being used in the paper industry to improve the retention of fines & pigments.
6-7c *American Cyanamid Co.

Silica..... Bulletin I-110 describes the use of colloidal silica dispersion in textile processing & finishing. Covers use for protecting weave structure.
170E Monsanto Chemical Co.

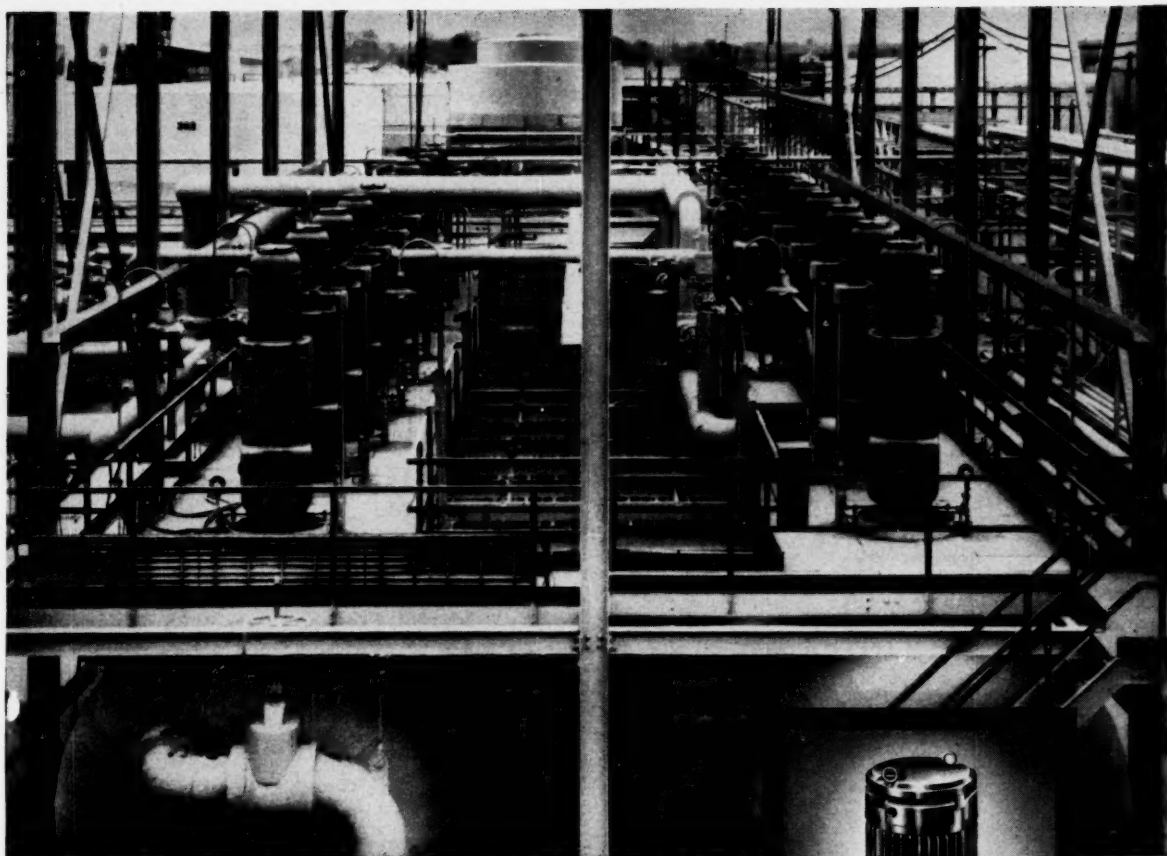
Surfactants..... 22 p. booklet describes a variety of uses of company's Igepal surfactantes in the manufacture of pulp & paper. Lists 4 products, describes specific use.
170F General Dyestuff Co.

Tetrahydrofurfuryl Alcohol.....Complete information on the chemistry, physical properties, and uses of tetrahydrofurfuryl alcohol contained in Bulletin 206.
63 *The Quaker Oats Co.

Unrefined Calcium Lignosulfonate..... Norlig is covered in detail in Bulletin 126. Uses of Norlig and a graph showing Dilution Curves of liquid Norlig are included.
170G Marathon, Div. American Can Co.

Zirconium.....The largest zirconium ingot, 13,200 lbs., was melted from zirconium chunklets produced by company's exclusive sodium reduction process.
33-34c *U. S. Industrial Chem. Co.

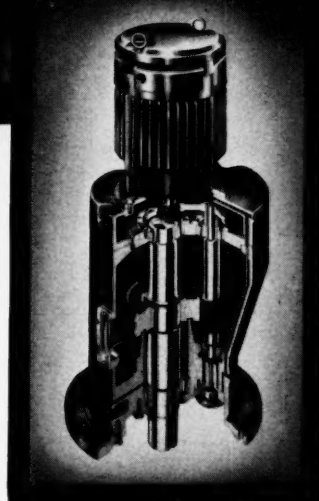
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50 HP Philadelphia Mixers in continuous operation...

PROOF OF BETTER SHAFT SEALING.

Each of the forty-two Philadelphia Mixers in this pressure vessel mixing operation can produce 99,000 pound-inches of torque for continuous operation under difficult loading conditions . . . the kind of job where anything less than the best agitator shaft operation is an invitation to mechanical seal problems. *Significance:* Philadelphia Mixers have two important advantages over *all* other fluid mixers which assure best output shaft performance in difficult operations.



FIRST. In any comparative evaluation of mixers having equivalent torque capacity, a Philadelphia Mixer will *always* have the largest, heaviest duty, highest capacity bearings . . . and the drive with the best bearing support for shafting will have the truest running shaft.

SECOND. Because the bearings in Philadelphia Mixers are larger, the diameter of the output shaft is larger . . . and the design which has the largest diameter shaft will have least shaft deflection from hydraulic loads imposed on the mixing impeller during operation.

THESE ADVANTAGES come at no cost premium . . . you just get more mixer for your money. Six standard models, 1 to 200 HP. Special units to 500 HP. Horizontal or vertical motor drive. Mechanical seal or packed stuffing box. Paddle or turbine type impellers. Write for catalog A-19.

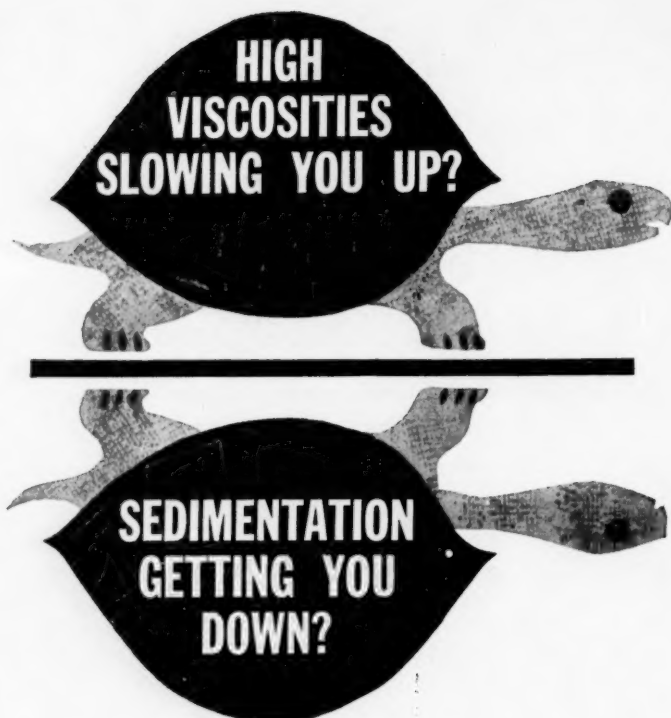
philadelphia mixers

PHILADELPHIA GEAR CORPORATION

Erie Avenue and G Street • Philadelphia 34, Pennsylvania

Offices in all Principal Cities • Virginia Gear & Machine Corp., Lynchburg, Va.

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS



If high viscosity is slowing your processing of an aqueous slurry, try adding a Marasperse® dispersant.

Or if your customers complain of sedimentation when they mix your product with water, put a Marasperse in your formulation.

Only a little Marasperse is needed to reduce slurry viscosities, or to prevent micron-sized particles from settling out of suspensions. Usually less than 3%, based on the weight of the solids in the aqueous system, will do the job for you.

For example, manufacturers of gypsum board require just 0.15% Marasperse in their stucco slurries to give them more fluidity at lower water contents . . . And producers of pesticide wettable powders include but 1.5% to 2.0% Marasperse in their powders to ensure satisfactory dispersion in spray tanks. What's more, the Marasperse cost only a few cents a pound!

Tell us about your viscosity or suspensibility problem. If it's typical of one of the many that the Marasperse dispersants have licked, we'll give you specific information based on user experience. If it's something new or unique, we'll tell you how to test samples of the Marasperse to determine whether or not they'll be useful to you.

MARATHON

A Division of American Can Company
CHEMICAL SALES DEPARTMENT
MENASHA, WISCONSIN



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LITERATURE . . .

Construction Materials

Alloy Detailed information on the corrosion resistance of Ni-o-nel alloy, its physical constants, tensile properties, & fabrication available in a new booklet.

172-A The International Nickel Co.

Alloys Ni-o-nel alloy resists attack by sulfuric, phosphoric, & nitric acids over a wide temp. & concentration range. Technical booklet available.

164 *International Nickel Co.

Aluminum Bus Conductor handles easily and easy to bend and form to your needs. Up-to-date facts and figures on lightweight Aluminum Bus Conductor.

93 *Aluminum Co. of America

Coating, Zinc is completely non-flammable, nontoxic & is insoluble in all petroleum products. Applied by brush, spray or roller. Resists temp. up to 600°F. Details.

135 *Amercoat Corp.

Corrosion Control Claimed to be most comprehensive treatise on rust and corrosion control, catalog describes system of primers and colored top coatings.

172B Rust-Oleum Corp.

Fabrication Production-line fabrications shop is completely equipped to convert the steel plate of your choice into completely-fabricated assemblies. Details.

18-19 *Colorado Fuel & Iron Corp.

Insulation A selection of over thirty different specialized insulation products for service from sub-zero to 1900 F. The new 1960 catalog is offered.

80 *Baldwin-Ehret-Hill

Insulation Thermal insulations for all industrial requirements, in applications from -400 to 3,000 F. are covered in new 54-page catalog. Illustrated.

172C Johns-Manville

Insulation, Pipe is available in full range of standard pipe sizes & in block form. Single thickness to five inches. Specials to 44" O.D. Bul. No. 65610.

65 *Union Asbestos & Rubber Co.

Packings Lattice-Braid teflon packings are strong, long-lasting and chemically inert. Withstand temperatures from -120 F. to +500 F. Catalog AD-131.

20-21c *The Garlock Packing Company

Plastic Packings come in 5 different types. They are designed for use on steam rods, valve-stems, centrifugal pump shafts, etc. Further information.

196 *Raybestos-Manhattan, Inc.

Tantalum Technical data bulletin 3.506-2 contains engineering information and typical examples of acidproof Tantalum for the chemical industry.

172D Fansteel Metallurgical Corp.

Refractory Metals Bulletin 978 describes tantalum, titanium and zirconium in terms of process characteristics, applications and custom equipment available.

172E Pfaudler

* From advertisement, this issue



clean stack at

Dragon Cement!

DRACCO GLASS-BAG FILTER HALTS AIR POLLUTION

BY COLLECTING KILN DUST AT 600° F.

The unretouched photograph shows the dramatic result produced by a Draco Glass-Bag Filter at Dragon Cement Co., division of American-Marietta Co., Northampton, Pa.

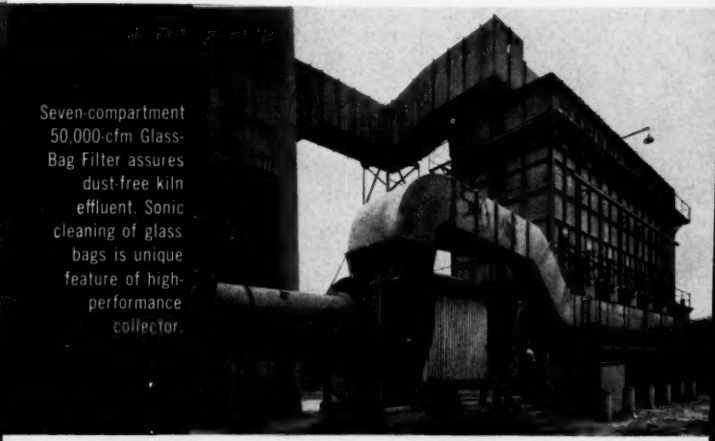
The kiln is running at full capacity—but no visible dust is escaping from the stack connected to the Glass-Bag Filter. The filter is collecting the extremely fine dust with virtually 100% efficiency. Duplicate equipment has been ordered to eliminate visible dust from the other stack.

Convinced that this is the best answer to air pollution from kiln stacks, Dragon has ordered three more Glass-Bag Filters. Soon all stacks will be clean at Dragon!

Exclusive dust removal techniques assure extra-long bag life. At Dragon, Draco's patented SONOCLEAN unit safely cleans the bags with sonics. Sound waves gently dislodge dust without wear or fracture of the cloth.

Modular, compartmented design gives flexibility to meet any capacity requirement and simplifies servicing. Worker comfort during servicing is assured by interior insulation.

Dracco Glass-Bag Filters, the first successful glass cloth collectors, are now collecting hot, corrosive dust and fumes in many industries—cement, chemical, metallurgical. Gases to 600° F. can be introduced into the filter where specially treated glass bags retain all visible dust.



Seven-compartment
50,000-cfm Glass-
Bag Filter assures
dust-free kiln
effluent. Sonic
cleaning of glass
bags is unique
feature of high-
performance
collector.

*For further information on Glass-Bag Filters,
today's most advanced equipment for air pollution
or hot dust problems, contact: Dracco
Division of Fuller Company, Harvard Avenue and
E. 116th Street, Cleveland 5, Ohio.*

DRACCO airstream conveyors
dust control equipment



One operator with very little training
can run a whole bank of CVC stills...



with throughput up to 2 tons an hour...

for only .06 to .1 cent a pound.

16 tons for \$32

CVC high vacuum stills cut process cost

Now, for less than 1/10 cent a pound, you can separate tall oil, vitamin concentrations, plasticizers, waxes... hundreds of other organic and silicone compounds in the 250 to 4000 molecular weight range.

CVC continuous production stills run virtually unattended; fully automated, if you prefer. Economical low heat reduces product waste, gives you higher yield. 4 sizes: from 2 pounds to 2 tons an hour... 16 tons each 8-hour shift.

Write for High Vacuum Still Bulletin 3-1...
and for details on test runs of your samples.

Consolidated Vacuum Corporation

ROCHESTER 3, NEW YORK

A SUBSIDIARY OF CONSOLIDATED ELECTRODYNAMICS CORPORATION
(FORMERLY ROCHESTER DIVISION)



LITERATURE...

Electrical & Mechanical

Air-Break Starter.....The complete story on certified fuseless fault protection for high-voltage motor drives is contained in Bulletin 8130A.
73 *Square D Company

Automatic Valve Controls.....Electrodyne is a valve type-control for a wide variety of applications in chemical & power plants, oil & gas industries, etc. Details.
150 *Hupp Aviation Div.

Electrical Equipment.....A complete line of explosion-proof electrical equipment such as; electrical fittings, lighting, panelboard & other equipment.
1 *Appleton Electric Co.

Electric Impact Wrench.....The tool's one-half inch square drive takes sockets 3/8 to 1 1/16". Two models; 115 volts, 220/230 volts. Full details. available on request.
170 *Snap-On Tools Corp.

Expansion Joints.....Catalog AD-137 contains complete information on solid teflon and teflon-lined expansion joints for the chemical processing applications.
20-21b *The Garlock Packing Co.

Gaskets, Teflon-jacketed.....in 4 basic designs; slit envelope, milled envelope, formed shield, double jacket & a wide selection of filler materials & thicknesses. Cat. AD-154.
20-21a *The Garlock Packing Co.

Lighting Fixtures.....Complete information on lighting fixtures equipped with the new slotted reflectors is available. Reduce fatigue, accidents and worker tension.
44 *Crouse Hinds

Mechanical Seal.....Dura Seal meets a wide range of pressures, temperatures and liquids. Information on types of Dura Seals to meet your sealing needs in Catalog 480.
L186 *Durametallic Corp.

Mechanical Seals.....Chemiseal mechanical seals are available in standard sizes to fit all pump shafts 7/8" to 2 1/4" shaft. Details in Catalog AD-164.
20-21d *The Garlock Packing Co.

Motor Reducers....."Philadelphia Vertical Motoreducers and In-Line Reducers" is a complete selection guide for motor reducers useful with various process machines.
174A Philadelphia Gear Corp.

Motors, Open-Type.....Super-Seal motors feature Poaxel and Silco-Flex insulations. Complete information on Super-Seal motors is now available on request.
82 *Allis-Chalmers

Silicon Power Rectifiers.....Built to supply virtually any desired voltages and currents, flexible silicon power rectifiers claim low installed space. Bulletin.
174B I-T-E Circuit Breaker Co.

Swivel Joints.....The DS series with interchangeable packing feature can handle a wide range of chemicals in services from -65 to +400 F at 300 PSI. Bulletin 1258.
121 *Chiksan Company

*From advertisement, this issue

NEW...from DELHI-TAYLOR

DELHI-SOLVENT

No. 250

LOW ODOR · FAST DRYING

HI FLASH POINT



CHEMICAL DIVISION
DELHI-TAYLOR

CHEMICAL MATERIAL SPECIFICATIONS

Solvent 250

Delhi-Solvent No. 250 is a water white, low end-point mineral spirit solvent with low odor level and a flash point of 104° F, an ideal solvent for the paint, printing ink, dry cleaning, metal cleaning and other fields. Its narrow distillation range and low final boiling point are indicative of its fast drying characteristics. Solvent 250 is sulfur free and of excellent quality and uniformity.

Available by tank car, tank truck, barge and ocean tanker from the plant at Corpus Christi and from bulk terminals in Houston, Baton Rouge and Chicago.

TYPICAL ANALYSIS

Gravity, API	49.2
Specific Gravity 60°F/60°F	0.7831
Weight, Lbs./Gal.	6.520
Color, Saybolt	30+
Kauri Butanol Value	39
Sulfur	Free of H ₂ S, SO ₂
Doctor	Negative
Copper Corrosion	Pass
Flash Point, TCC	104 °F
Aniline Point	128 °F
Distillation—IBP 312°F —FBP 349°F	



CHEMICAL DIVISION DELHI-TAYLOR OIL CORPORATION

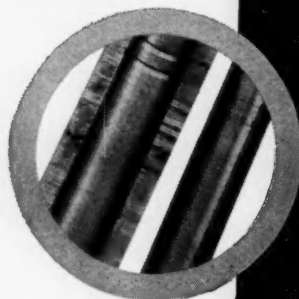
CORRIGAN TOWER, DALLAS 1, TEXAS

415 MADISON AVE., NEW YORK 17, N. Y.

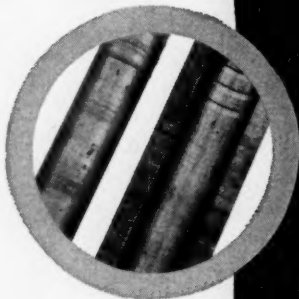
CORPUS CHRISTI • CHICAGO • CHARLESTON • BATON ROUGE • HOUSTON

NEW ELLIOTT TUBE EXPANDERS roll tubes into thick sheets in one pass

Use of **NEW**
continuous-rolling
technique here—
shows uniform seal,
with all Keys
preserved, and
no signs of shear



OLD
step-rolling method
results in non-uniform
surface . . . distortion
of Keys where rolls
have overlapped



Better seal . . . Smoother surface . . . Much Faster operation

This new concept in tube expanders was developed by Elliott to roll the thickest tube sheets. Using a continuous-rolling method, it eliminates many problems common to step-rolling, may be operated protractively or retractively, saves time, assures uniform, smooth surfaces, avoids annular voids or erratic tube inside diameters, provides better seal.

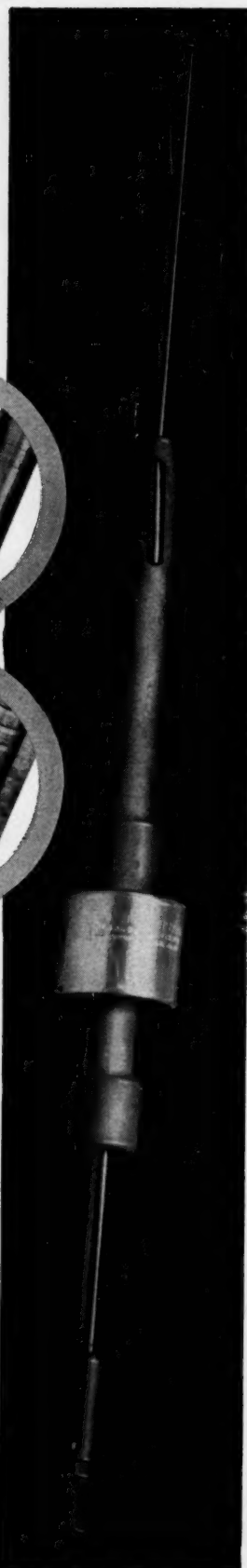
Accessories

Elliott also makes a complete line of retubing accessories, including both electric and air magnetic Tube Rolling Controls, Tube Gages, Tube Plugs, Tube Cutters, etc.—in addition to a complete line of tube expanders. Ask for Bulletin Y-52.

ELLIOTT
Company

LAGONDA PLANT, SPRINGFIELD, OHIO

Y9-5



LITERATURE . . .

Torque Converters New 14-, 15- and 16-in. torque converters for industrial power transmission applications are described in Bulletin FFS-5. Copies on request.
176A Clark Equipment Co.

Handling & Packaging

Bulk Elevator Conveyor Econ-O-Lift permits rapid, economical handling of bulk loads without breakage, marring or dusting. Descriptive brochure offered.

T142 *The Creamery Package Mfg. Co.

Bulk Handling System The Tote System offers compact storage, accurate & automatic weighing & blending, etc. New catalog contains complete details.

36 *Tote System, Inc.

Chemical Containers Hackney chemical containers are built of types 304 & 316 stainless steel. Hold approximately 15½ gallons of liquid. Details.

13 *Pressed Steel Tank Co.

Fork Trucks Brochure gives dimensions and engineering specifications of the Clarklift C-25, a gas-powered fork truck of 2,500 lb. capacity. Illustrated.

176B Clark Equipment Co.

Material Handling Complete details on how the Michigan tractor shovels ease of handling speed and dependability can help you is now available on request.

113 *Clark Equipment Co.

Materials Handling Dinosaur picks up automatically. Containers available up to 40 cu. yds. & over . . . loads are limited only by the capacity of truck. Brochure.

169 *Dempster Brothers Inc.

Pneumatic Lift Truck The 6,000 lb. model available with choice of single or dual front wheels, standard or power shift transmission, diesel, gasoline or LP gas engine.

194 *Allis-Chalmers

Polyethylene-Lined Drums New type has an outer pack which consists of wood members reinforced with double-dipped, galvanized steel binding wires & staples.

33-34e *U. S. Industrial Chem. Co.

Vibrating Conveyors features an exclusive dual-shaft vibrating mechanism with splash oil lubricating system. Complete information in illustrated bulletin No. 5602.

180 *Lecco Machinery & Engr. Co.

Heating & Cooling

Boilers, Packaged Complete information on packaged boilers (15 to 600 HP) and how they fit into your expansion or replacement plans are available on request.

149 *Cleaver-Brooks

Coolers, Dryers Booklet covers electric and mechanical vibrating-type coolers and dryers of both direct and indirect type. Section on auxiliary equipment included.

176C Jeffrey Mfg. Co.

* From advertisement, this issue



Anhydrous Ammonia
Anti-Corrosion Liquid
Brine
Caustic Catalyst
Caustic, 50% Solution
CO₂, Liquid
Diethylene Glycol
Di-propargyl Ether
Hydrocarbons

WHAT CHEMICALS ARE GIVING YOU PUMPING PROBLEMS?

Methanol Amine
Naphtha @ 300° F
Nickel Catalyst Slurry
Nitric Acid
Pulp Density Mineral Ore
Silica Gel
Slurry
Sulfuric Acid
Tanning Solution
Urea
Water

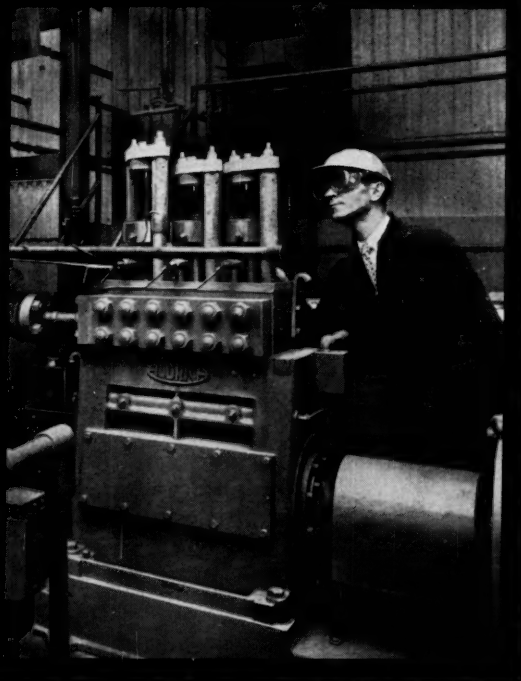
Where the pressures are high . . . or the liquids are tough to handle . . . that's for us!

The list above is typical of the special pumping problems we have solved for the process industries . . . problems that call for an intimate knowledge of what it takes to handle corrosive, viscous, abrasive or highly compressible fluids over a wide range of pressures and temperatures.

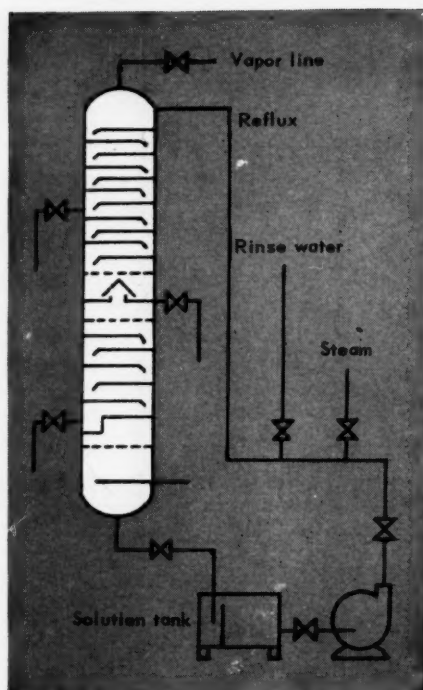
This specialized experience is ready to work on your specific pumping problems . . . to explore them in depth and find a *better* answer, not just *an* answer.

Aldrich Pumps range from 25 to 2500 hp.; pressures to 50,000 psi. For fast reference see our insert in *Chemical Engineering Catalog*. For complete data write ALDRICH PUMP COMPANY, 3 Gordon Street, Allentown, Penna.

The tough pumping problems go to



Towers ...
Tanks
Pumps
Compressors
Exchangers
Condensers
Lines
Fittings
Valves



Clean them fast the Oakite way ...chemically!

Now you can clean process equipment without dismantling ... without scraping, rodding, sandblasting ... without lengthy off-stream breaks in production.

The new quick way is by in-place chemical circulation, using Oakite specialized materials and methods. Those tough deposits that form in the manufacture of such chemicals as acetylene, polyethylene, carbon tetrachloride, glycols, synthetic resins—to name just a few—are removed speedily, safely, at low cost.

Savings that can result are impressive. Talk the subject over with your local Oakite Technical Service Representative, or write for technical bulletin to Oakite Products, Inc., 16H Rector Street, New York 6, N. Y.



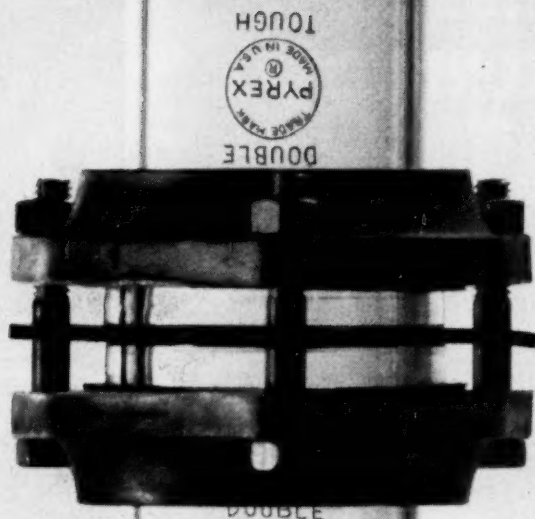
Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

LITERATURE . . .

- Dryer, Double-Shell**.....for drying without contamination. Shell rotation speed and shell slope easily changed. Further details in Bulletin AH-472.
183b *Hardinge Co., Inc.
- Dryer, Single-Shell**.....Arranged for either parallel or counter-flow operation. Mounted on structural steel base. Has removable "knockers." Bul. AH-471.
183a *Hardinge Co., Inc.
- Dryer, Steam Tube**.....Can be connected to any available steam supply or furnished with a 3-HP steam generator. Easily moved from place to place. Bul. AH-473.
183c *Hardinge Co., Inc.
- Dryers**.....Bulletin covers manufacturer's line of continuous drying equipment, for production or pilot plant. Deals with continuous conveyor and spray dryers.
178A Proctor & Schwartz, Inc.
- Dryers, Spray**.....A new full-color bulletin SW 401 "Swenson Parallel Flow Spray Dryers" gives information on evaporators, pulp washers & crystallizers.
57 *Swenson Evaporator Co.
- Heat Exchangers**.....Heat exchange equipment for virtually all conditions and applications. Full story on heat exchangers in Bulletin 0.4A9.
81 *American-Standard
- Heat Exchangers**.....New 4-color Bul. 820 describes & illustrates the complete line including Standardized Heat Exchangers that fulfill nearly all normal requirements.
158 *Manning & Lewis Engr. Co.
- Heaters**.....Catalog 60 on general industrial heating applications. More than 15,000 different types, sizes & ratings of electric heaters & heating elements.
157 *Edwin L. Wiegand Co.
- High Vacuum Stills**.....Four sizes; from 2 lbs. to 2 tons an hour ... 16 tons each 8-hour shift. Bul. 2-1 and details on test runs of your samples.
174 *Consolidated Vacuum Corp.
- Ovens**.....for unmatched drying quality. Bench, Cabinet, Truck and Conveyor types offer convection heating for fast, uniform heat processing. Bulletin 127.
B140 *W. S. Rockwell Co.
- Plate Heat Exchangers**.....All heat transfer surfaces can be exposed for manual cleaning with a minimum of trouble. Further information is available.
10-11b *The De Laval Separator Co.
- Steam Jacketed Kettles**.....meet every processing and mixing need. Size & type for every process or product are covered in book of engineering data & specification sheets.
R139 *Groen Mfg. Co.
- Steam Traps**.....All 5 types of steam traps: Thermo-Dynamic, Thermostatic, Float Thermostatic, Liquid Expansion, and Bucket. Literature & help in solving problems.
16-17 *Sarco Co., Inc.
- Vapor Condenser**.....The "Aero" Vapor Condenser holds temperatures to close limits in entire processing column. Descriptions & capacities in Bulletin 129.
168 *Niagara Blower Co.

*From advertisement, this issue



How to run a simple test study on PYREX® pipe and corrosion

A few hours and a few dollars may be enough to end corrosion in your piping altogether.

Choose a process line where you have the worst corrosion. Put in a length or a section of PYREX pipe. Sit back and let the pipe go to work.

We are positive you'll learn two things from this study.

You'll find the PYREX pipe can indeed end your corrosion problems unless you're handling large quantities of hydrofluoric or glacial phosphoric acid, or hot alkalis. Any other chemical or combination of chemicals should slip through without a trace of corrosion.

You'll find that PYREX pipe installs so much more easily and so much faster than most other materials that it is actually one of the least expensive piping materials you can use.

Your local PYREX pipe distributor can show you how to attach this pipe to your present lines—fittings are available for making attachment to any type of process pipe. See our insert in Chemical Engineering Catalog. Or, if you prefer, you can write direct to us for a copy of PE-3, the PYREX Pipe Bulletin. Address: Plant Equipment Sales, 1 Crystal Street, Corning, N. Y.



CORNING GLASS WORKS
CORNING MEANS RESEARCH IN GLASS

DUAL-SHAFT VIBRATION for POSITIVE MATERIAL CONTROL with **LECCO VIB** VIBRATING CONVEYORS



*SHAKE OUT
HIGH PRODUCTION COSTS!*

An exclusive dual-shaft vibrating mechanism with splash oil lubricating system sets up the **LECCO VIB** vibrating conveyor for efficient and economical screening, dewatering, conveying and feeding in one positive motion . . . allows for fast, easy adjustment of angle of material lift . . . assures high capacity, low maintenance operation.

Friction controls and angular coil spring mountings of the **LECCO VIB** conveyor confine vibration to vibrated frame . . . eliminates heavy support structure and tie-down bolts . . . requires minimum space . . . and even enables its use as a portable unit.

For complete information about the **LECCO VIB** vibrating conveyor, write for illustrated bulletin No. 5602.

**Lecco Machinery and
Engineering Co.**

BLUEFIELD, WEST VIRGINIA

Subsidiary Fairmont Machinery Company

LITERATURE . . .

Instruments & Controls

Analog Computer Control . . . Details on the control system, the magnetic control units, the patchboard, & information on determining computer requirements in Bul. MSP-163. 55 *Hagan Chem. & Controls, Inc.

Analyzers . . . Analysis of fluorine compounds within 30 sec. by the Model 105 Nuclear Magnetic Resonance Analyzer is described in 4 p. Material Study Report 34.58. 180A Schlumberger Well Surveying

Chromatography . . . Gas-Liquid chromatography of fatty derivatives is covered in two 4 p. articles: Separation of Homologous Series; Analysis of Fatty Alcohol Mixes. 180B Beckman Instruments, Inc.

Control Element . . . A 29-page booklet describing the origin & operation of the snap-acting disc type thermal element called the Spencer Disc is now available. 180C Metals & Controls Div.

Control Units . . . Standard duty, heavy duty, & oiltight have double break, silver alloy contacts to assure reliable operation. Publication 6090 offered. 143 *Allen-Bradley Co.

Controls . . . Application Engineers can analyze your control systems from the standpoint of over-all plant design, operation and maintenance requirements. 61 *Black, Sivalls & Bryson, Inc.

Digital Tape Systems . . . Brochure 1618 details digital magnetic-tape recorder/reproducer systems. Description of operating characteristics and specifications. 180D Consolidated Electrodynamics

Gages, Heated . . . In the complete line there is a model to meet your specific needs . . . heated by steam or electrically . . . heavy or viscous liquids. Catalog offered. L185 *Jerguson Gage & Valve Co.

Hydrocarbon Detector . . . gives rapid analysis of total organically bonded carbons in gases, with sensitivity better than 0.1 ppm. Additional information No. 1552. 33-34h *U. S. Industrial Chem. Co.

Lab Instruments . . . Catalog acts as reference guide that provides brief, concise descriptions of instruments for quality control, research, etc. applications. 180E Beckman

Motor Controls . . . Catalog 5900 provides condensed listing of starters, magnetic controls, drum controllers and pressure switches. Selection charts. Price, ordering data. 180F Furnas Electric Co.

Oxygen Analyzer . . . Detailed specification on an oxygen analyzer that withstands tough environments & gives you continuous, dependable answers in Data File 14-5-08. 35 *Beckman Instruments Inc.

Potentiometers . . . Electronik potentiometers feature Servo Motor, Constant Voltage Module, Measuring Circuit Module and Amplifier Module. Full details on request. 8-9 *Minneapolis-Honeywell

* From advertisement, this issue

LITERATURE . . .

Recorders, Controls. Specification sheet describes new ElectriK Tel-O-Set recorders and recording control stations. Input from matching transmitter or transducer.
181A Minneapolis-Honeywell

Telemetry System. Bulletin CP 3707 describes and illustrates applications of the Pulse Code telemetry system for remote transducers, gages. On request.
181B Vapor Recovery Systems

Thermocouples. Catalog 300 covers Conax Con-O-Clad mineral-insulated thermocouples. Ordering steps for 24,000 assemblies outlined in detail. Specifications also.
181C Conax Corporation

Thermo-Panel Coil. Complete facts and prices on the latest models assuring further increased capacity, now available on request. Send for your copy.
TL187 *Dean Products, Inc.

Pipe, Fittings, Valves

Condenser Tube. Wolverine Trufin, the integrally finned condenser tube is available in a wide choice of metals, alloys & sizes in Type H/A, H/R, I/L, L/C, S/T.
83-84 *Calumet & Hecla, Inc.

Hose Fittings. Illustrated catalog of hose fittings and hose available on request. Single and double braiding; some reusable. Specifications and diagrams.
181D Lenz Co.

Jacketed Fittings. New catalog gives diagrams, charts of sizes and other pertinent information on jacketed fittings, gate valves, plug cocks, expansion joints and strainers.
181E J. P. Devine Mfg. Co.

Pipe. All purpose rigid PVC in schedules 40, 80, & 120, 1/2 to 4". Threaded on socket-weld fittings. Valves 1/2 to 2". Bulletin CE-56 sent on request.
144a *American Hard Rubber Co.

Pipe. Saran lined pipe, fittings, valves & pumps are available for systems operating from vacuum to 300 psi, from below zero to 200 F. Information available.
32 *Saran Lined Pipe Co.

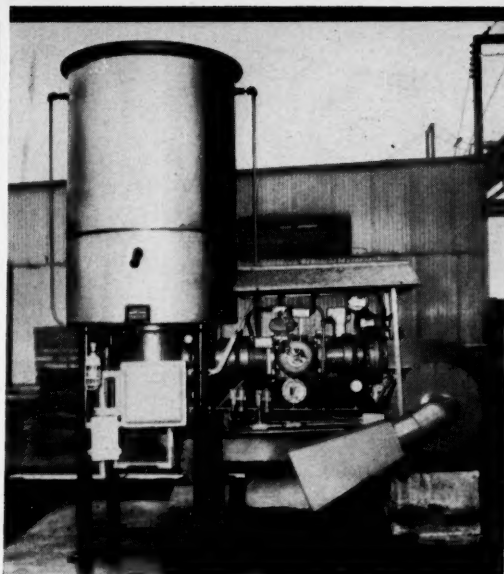
Pipe, Plastic. Flexible poly pipe is ideal for water lines, drains, underground pipe or conduit. In sizes 1/2 to 2", long coils. Details in Bul. CE-57.
144c *American Hard Rubber Co.

Pipe, Pyrex. is rugged, chemically inert & it withstands extremes of thermal shock. Facts on application design, and installation in Bulletin PE-3.
179 *Corning Glass Works

Tube Expanders. New tube expanders roll tubes into thick sheets in one pass. Bul. Y-52 outlines the complete line of retubing accessories plus tube expanders.
176 *Elliott Co.

Tubing, Stainless. Types 304 and 316 are available in all popular sizes & gauges. Up-to-date Selecting and Buying Guide. Send for Bulletin T.D. 120.
141 *The Carpenter Steel Co.

*From advertisement, this issue



Packaged THERMAL Waste Burner System installed at The Trubek Laboratories Inc. is used to burn waste solvents and mixed aromatics. It provides automatic and complete, odor-free incineration.

SOLVE CHEMICAL DISPOSAL PROBLEMS with a THERMAL WASTE BURNER SYSTEM!

Long established as one of the most efficient heat sources available to industry, THERMAL high heat release burner equipment provides rapid, efficient, economical incineration of combustible liquid and gaseous wastes. Because of its unique design, wastes can be fed directly into the burner, eliminating the need for bulky, expensive incinerators. THERMAL installations are compact, flexible and require minimum maintenance. Efficient heat recovery can also be arranged. Find out how this system can solve your waste disposal problems. Write today for information.

THERMAL WASTE DISPOSAL SYSTEMS have proved their effectiveness with these waste materials:

GASEOUS

Wax kettle fumes
Phosgene
Smelter fumes
Hydrogen Sulfide
Plastic plant wastes
Ammonia fumes
Phthalic Anhydride
Acetylene, methane & hydrogen mixture
Carbon disulfide vapors

LIQUID

Acetone-Acetic acid mixture
Ethyl alcohol
Phenol still residues
Diethylenetriamine Tar
Paint & Lacquer residue
Organic insecticide wastes
Nitrated & chlorinated aromatics
Ethyl ether
Dimethylformamide & formic acid
Benzene

✱ Use THERMAL's extensive lab facilities for trial burnings of your waste materials. Our engineering staff is available to do complete turn-key designs to meet your specific needs.

T H E R M A L

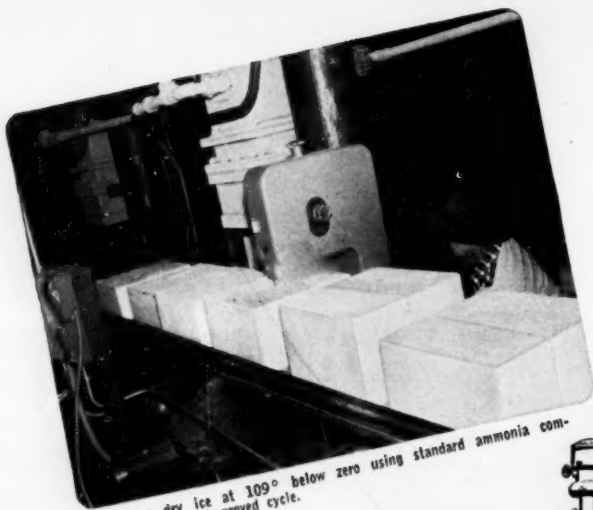
Thermal Research & Engineering Corp.

CONSHOHOCKEN • PENNSYLVANIA

REPRESENTATIVES IN PRINCIPAL CITIES



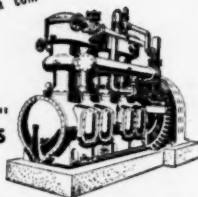
• Other Thermal Products & Services:
• Gas, Oil & Combination Burners
• Heat Exchangers
• Air Heaters
• Gas Generators
• Submerged Combustion
• Combustion & Heat Transfer Equipment



Making dry ice at 109° below zero using standard ammonia compressors in an improved cycle.



"HEAVY DUTY" COMPRESSORS

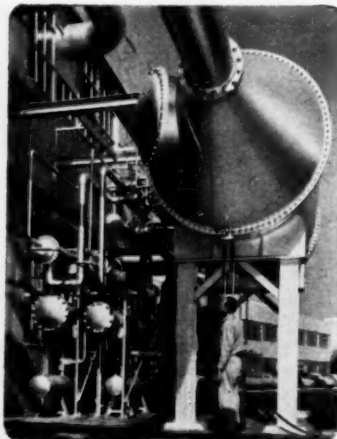


ENGINEERS

WILL DESIGN . . . BUILD and
INSTALL FRICK SYSTEMS . . .

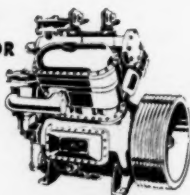
to solve your most difficult
cooling problems.

If you need any type of industrial or commercial cooling—for quick freezing, cold storage, ice making, humidity control, low temperatures, condensing, air conditioning, or any process work—contact the nearest Frick Branch or Distributor for recommendations and estimates.

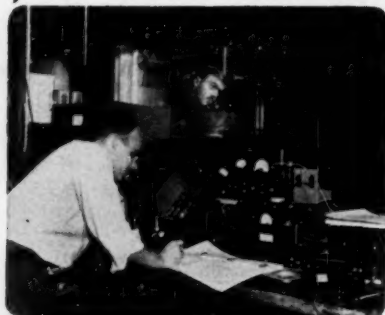


Cooling air under pressure for supersonic speed tests.

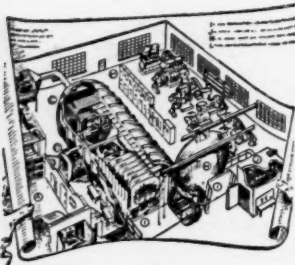
"ECLIPSE" COMPRESSOR



DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U.S.A.



Test laboratory work for temperatures down to 140° below zero.



All-weather Laboratory built for U. S. Army. Uses 3-Stage compressors, maintains Arctic, tropic and stratospheric conditions.

LITERATURE . . .

Unions. for use with flammable liquids & gases are tested by Underwriters' Laboratories, Inc. Complete facts including prices are available on request.
59 *Rockwood Sprinkler Co.

Valves, Fittings, Unions. Catalog F-10 contains complete information on types & trims to best meet severe fluid & gas handling duties at all temps. & pressures.
94 *Henry Vogt Machine Co.

Valves. Non-lubricated Ball Valves feature full bore conduits, Teflon stem gaskets & seats that are sealed from the lading flow. Sizes 1/2" through 6". Cat. 1000.
12 *W-K-M Div. of ACF Industries

Valves. to handle practically every corrosive fluid. Valves of every design and in the largest selection of metals & alloys. Further information on request.
123 *The Wm. Powell Co.

Valves, Ball. available in piping sizes 3/8" through 16" in screwed ends 150 lb. & 300 lb. flanges. All sizes available with 2 retainer springs & 2 Teflon seats. Folder.
41 *Rockwood Sprinkler Co.

Valves, Butterfly. Comprehensive catalog gives information on line of rubber-seated butterfly valves and operators. Data on construction, operation and materials.
182A Darling Valves & Mfg. Co.

Valve, Gate. Bulletin NP-76E describes and illustrates the nylon disks used as seats on Gate Valve No. 76. Recommendation chart on chemical applications on request.
182B OPW-Jordan

Valves, Pinch. for corrosive & abrasive gulls & liquids. Pressures to 150 psi, temperatures to 200 F. Catalog gives complete data & list of recommended applications.
L139 *The Mine & Smelter Supply Co.

Valves, Plastic. Revised edition of Handbook No. 1159 includes three new plastic products; 3-way valve, foot valve, & Dri-Seal No. 5. Illustrations & specifications.
182C Chemtrol

Valves, Stainless Steel. A new catalog outlines patterns you want in a choice of alloys that satisfy the requirements of practically all corrosive services.
77 *Jenkins Bros.

Process Equipment

Agitators & Mixers. Turbine-type propeller (to 120" in tanks to 50' dia.), slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units. Bul. A2-B2.
148a *Denver Equip. Co.

Attrition Scrubbers. High power-input to efficiently remove sand coatings, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56" x 56". Bul. A-8505.
148b *Denver Equip. Co.

Ball & Rod Mills. offer operation & convertibility. Wet or dry grinding systems. Sizes to 10' x 20'. All steel construction. Send for bulletin B2-B20.
148c *Denver Equip. Co.

*From advertisement, this issue

LITERATURE . . .

Centrifugals......Batch-O-Matic can handle highly corrosive materials under exacting standards of purity. Illustrated details plus information on Tolhurst machines.
163 *American Machine & Metals

Centrifuge......The C-41 Super D-Hydrator is designed for both atmospheric and pressurized operation, & is available in various standard materials of construction.
117 *The Sharples Corp.

Centrifuges.....AC-VO "Nozzle-Matic" continuous discharge centrifuges offer high capacities for your recovery problems. Further information on request.
10-11a *The De Laval Separator Co.

Cloth Discharge Filter....Information on how this filter with the simple Fluid Tension Roller can be applied to your operation is offered. Designed to fit most type filters.
49 *Peterson Filters & Engr. Co.

Crushing & Grinding......Design provides easy access for cleanouts. Returns complete sample. Bulletin No. 067 gives full description of all laboratory machines.
156 *Sturtevant Mill Co.

Demineralizers......Four-page bulletin covers line of packaged, mixedbed demineralizers that are designed for process water applications. Sizes to 13,200 gph.
183A Cochrane Corp.

Desuperheater......The SK Venturi type is designed to reduce the temperature of super-heated steam to the lower temperatures for use in process operations. Bul. 6D.
29 *Schutte & Koerting Co.

Dust Collector......Bulletin 10-27-59 describes the Dustex Roto-Jet cloth dust collector. Centrifugal action separates much of dust before it ever reaches cloth.
183B Dustex Corp.

Dust Control......Bulletins F-75 and G-579 contain helpful planning information and air engineering data about dust filters for your particular application.
136 *The Day Co.

Filter......Durco-Enzinger features finger leaf spacers, wingwheel closure, tilting leaves, oscillating sluice, traveling sluice & cake thickness detector. Bul. EF/2a.
131 *The Duriron Co.

Filter......How five-way savings can be made in the continuous vacuum filtration of difficult slurries with use of the Elmcobelt continuous belt filter is topic of F-2053.
183C Elmcobelt Corp.

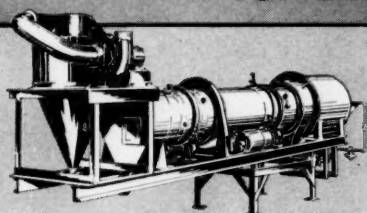
Filter Cartridge......Unique construction of the filter media guarantees increased solids capacity, lower pressure drop & uniform performance. Details on new "Feutron".
129 *American Felt Co.

Filter Fabrics......The handy information booklet, "Filter Fabric Facts", contains distributors names and answers problems related to your selection of filter fabrics.
159 *Wellington Sears Co.

Filter, Glass-Bag......for the toughest industrial applications such as; cement kilns, reverberatory furnaces, calciners, converters, etc. Detailed information.
173 *Dracoo Div. of Fuller Co.

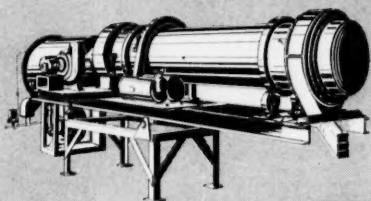
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Pilot Plant or Laboratory Equipment . . . for DRYING



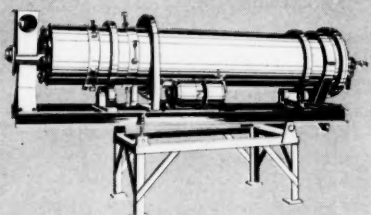
SINGLE-SHELL DRYER

Single-shell, direct gas fired rotary dryer. Arranged for either parallel or counter-flow operation. Mounted on structural steel base. Has removable "knockers." Bulletin AH-471.



DOUBLE-SHELL DRYER

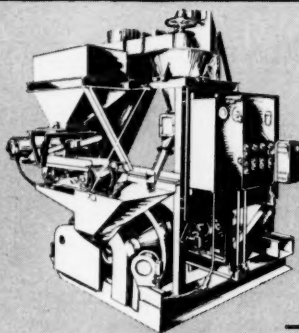
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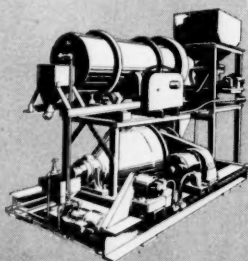
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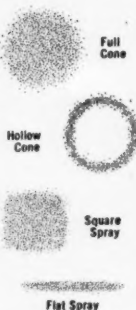
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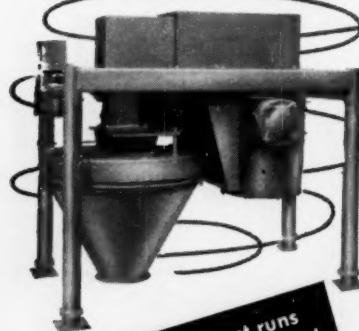


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LITERATURE . . .

Filters. . . . Niagara are available in completely automated models for production-line filtration. Operate with process streams from 5 to over 1,000 gal/minute. Data.

162 *American Machine & Metals, Inc.

Filters, Vacuum. . . . Concentric and flat leaf vacuum filters are topic of new bulletin. Both units made of heavy-duty, corrosion-resistant materials. Capacity charts.

184A B-I-F Industries, Inc.

Grinding & Classifying. . . . Bul. AH-448. Describes the Dry Grinding Unit 7/8" high, and the Wet Grinding Unit 6 1/2" high. Both are self-contained and portable.

183d *Hardinge Co., Inc.

Hermetic Centrifuge. . . . Corrosion-resistant and easy to clean, these centrifuges meet all the requirements of industrial service. Details on request.

10-11c *The De Laval Separator Co.

Horizontal Filter. . . . Type 122 Horizontal filter is described in detail in Bulletin 122. Engineered systems for your requirements through controlled filtration.

38 *Industrial Filter & Pump Mfg. Co.

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B184 *Entoleter Div., Safety Industries.

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148d *Denver Equip. Co.

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147 *Gabb Special Products Inc.

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200 *Mixing Equipment Co., Inc.

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197 *Netco Corporation

Mixers. . . . in 6 standard models, 1 to 200 HP. Special units to 500 HP. Available with horizontal or vertical motor drive, with paddle or turbine type impellers. Cat. A-19.

171 *Philadelphia Gear Corp.

Mixers, Batch. . . . Capacities: 5 qts. to 160 cu. ft. Hand & motor driven models. All sizes available in stainless steel, other alloys. Easy to clean.

T140 *Daffin Mfg. Co.

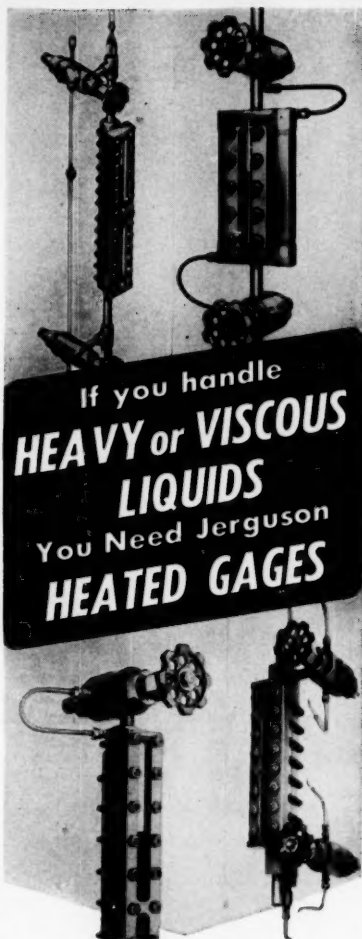
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160 *Eastern Industries, Inc.

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91 *National Engineering Co.

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Process Equipment. . . . "Sub-A" Flo-tation is available in sizes from 16" x 16" to 72" x 72". Three types: "Cell-to-Cell"; "Free-Flow"; Type "M". Bul. F10-B86.
 148f *Denver Equip. Co.

Process Equipment. . . . including drum flakers and dryers, rotary and conical vacuum dryers, vacuum shelf dryers, granulators, Tornado mills, furnaces, etc. Information.
 30 *F. J. Stokes Corp.

Process Equipment. . . . Brochure covers line manufacturer's mixers, roller mills and colloid mills. Describes operation and gives available sizes and capacities.
 185A Troy Div., Skinner Engine Co.

Processor. . . . A complete 24-page bulletin presents the story of the design, application and operation of the Turba-Film Processor. Bulletin 117.
 42 *Rodney Hunt Machine Co.

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 148k *Denver Equip. Co.

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 92 *Western Precipitation Corp.

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 148e *Denver Equip. Co.

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 R186 *Carrier Corp.

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LITERATURE . . .

Spray Nozzles. . . . Over 12,000 standard spray nozzles for more exact performance to fit your needs. Complete information available in Catalog No. 24. T184 *Spraying Systems Co.

Vacuum Tumble Dryers. . . . Technical literature on pre-packaged vacuum tumble dryers and details of the pre-testing facilities that are available. 46-47 *Patterson Kelley Co., Inc.

Pumps, Fans, Compressors

Air Handling System. . . . Illustrated brochure outlines the benefits, features and components of a Fluidizer system. Also describes Fluidizer valves. 186A The Fluidizer Company

Canned Pump. . . . Dynapump Bulletin 420-D gives features and specifications of low-cost, compact, leak-proof pump for industrial applications. On request. 186B Fostoria Corp.

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Pump. . . . Many types both horizontal and vertical shaft units, every one designed & constructed for use where ordinary pumps give trouble. Literature. T195 *Nagle Pumps, Inc.

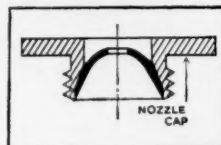
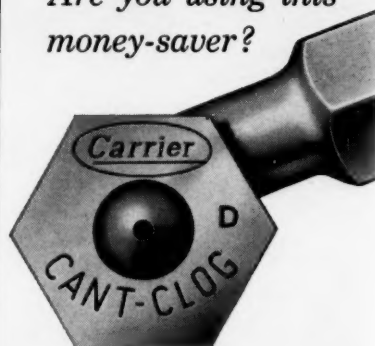
Pump. . . . New positive displacement handles without turbulence, pulsation, aeration or agitation, corrosive-problem liquids of high or low viscosity. Catalog P 302. 119 *Waukesha Foundry Co.

Pump, Chemical. . . . Bul. 59 contains typical applications, flow charts, description & specifications of models of various capacities & constructions & special leakage chart. 75 *Lapp Insulator Co., Inc.

Pump, Double Suction. . . . feature sturdy, machined casing with ample, simply-formed water passages . . . renewable bronze wearing rings etc. Full information in Bul. 955-S. 26 *Buffalo Forge Co.

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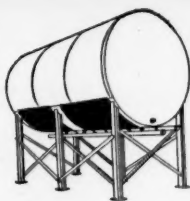
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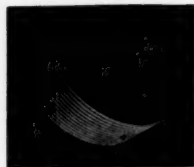


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144b *American Hard Rubber Co.

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177 *Aldrich Pump Co.

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148i *Denver Equip. Co.

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199 *A. R. Wilfley & Sons, Inc.

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31 *Robbins & Myers, Inc.

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148g *Denver Equip. Co.

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148h *Denver Equip. Co.

Services & Miscellaneous

Catalog..... offers reprints of technical journals and books long out of print but in great demand. Reprints are reproduced in book form by offset process. No. 1553.

33-34i *U. S. Industrial Chem. Co.

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187A Ansul Chemical Co.

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33-34j *U. S. Industrial Chem. Co.

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33-34g *U. S. Industrial Chem. Co.

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181 *Thermal Research & Engr. Corp.

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Dryer: Louisville 30' steam tube.
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Lydton Truck Dryer; 12' W., 7' High, 100' Long; 21 Car Capacity; with Turn Table, Electric Eye, controls, valves etc.
Truck Dryer, 30' L, 15' W., 11' High; 12 Car Capacity; Taylor Controls
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Stokes Vacuum Impregnator Model 5648; 100 PSI Internal and Jacket
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MISCELLANEOUS

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- 10—Steel Bubble Cap Towers, 2' to 12' dia., up to 109' high.
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- 1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
- 1—4000 gal. Haveg Vert. Tank 8'x12'.
- 1—1500 gal. Stainless Pressure Tank, 90#.
- 1—12,000 gal. horiz. steel pressure Tank, 7'6"x36', 200 PSI.
- 6—Stainless Heat Exchangers; 1220, 786, 536, 396, 315, 250, sq. ft.

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- 1—Sharples C-27 Super D-Hydrator, 316 S.S.
- 1—Bird 18"x28" 316 S.S. Solid Bowl, Continuous.
- 1—Bird 18"x28" steel, Solid Bowl, NEW, Continuous.
- 1—Bird 36"x50", 347 S.S. Solid Bowl, Continuous.
- 2—Sharples PY14, PN14, Super-D-Canterers, 316 S.S.
- 1—Bird 40" suspended, 347 S.S. perforated basket.
- 2—Sharples #16, 304 S.S., 3 HP motor.

MIXERS

- 1—#12 Sturtevant 304 S.S. Rotary Mixer, 450 cu. ft.
- 1—Baker Perkins #16TRM, 150 gal. jkted., Vac. 60 HP.
- 5—Day "Cincinnati" double arm, 250 and 100 gal.
- 1—1500# Powder Mixer, 7 1/2 HP XP motor.
- 2—Steel, jkted. Powder Mixers, 225 and 350 cu. ft.
- 1—#0 Simpson Intensive Mixer.

DRYERS

- 1—Louisville 54" x 35', Monel Rotary Steam Tube Dryer.
- 3—Buřlovak Vacuum Shelf, 20-60" x 80" shelves.
- 1—Devine Vacuum Shelf with 19-59" x 78" shelves.
- 1—Devine Vacuum Shelf with 10-40" x 43" shelves.
- 2—Buřlovak 42" x 120", atmospheric, double drum.
- 2—Devine 5' x 12', 4' x 9', single drum, atmospheric.
- 1—Baker Perkins 5'6" x 6' Rotary Vacuum Dryer.
- 1—Buřlovak 3' x 20' Rotary Vacuum Dryer, 316 S.S. Unused.
- 2—Louisville Rotary Steam Tube 6' x 25', 6' x 50'.
- 4—Rotary Dryers, 4' x 40', 6' x 50', 7' x 80'.
- 2—Louisville 8' x 50' Stainless Steel Lined Rotary Dryers.
- 1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
- 2—Link Belts; 7'5" x 25", 6'4" x 24', S.S. Louvre Dryers.

FILTERS

- 1—Oliver 6' dia. Horizontal Filter, 316 S.S.
- 1—Oliver 3' x 6' Steel Rotary Vac. Precoat Filter.
- 1—Niagara #370-38 Filter, 370 sq. ft., 304 S.S.
- 2—#49 Vallez Rotating Pressure Filters, 738 sq. ft.
- 1—Oliver 5'3" x 8' Steel Rotary Vacuum, vaporite housing.
- 1—Sparkler 33528 Filter, 150 sq. ft. 304 S.S.
- 2—Sparkler 18D8 Filter, 12.3 sq. ft., 304 S.S.
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- 2—96" dia. Vulcan, 30 trays—bubble caps, T316 SS.
- 1—96" dia. Vulcan, 10 trays—bubble caps, T316 SS.
- 2—60" dia. Vulcan, 10 trays—bubble caps, T316 SS.
- 1—48" dia. Vulcan, 25 trays—bubble caps, T304 ELC SS, 100 PSI.
- 3—24" dia. Vulcan, 12 trays—bubble caps, T316 SS—VACUUM.
- 6—T316 SS Packed Columns: 42", 36", 30" dia.
- 5—Steel Packed Columns: 60", 48", 36", 30", 20".

COLUMNS—COPPER

- 5—Vulcan copper bubble-cap columns, VACUUM! 72" x 40 plate; 48" x 25 plate; 48" x 22 plate; 24" x 20 plate.

FILTERS—CENTRIFUGALS

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- 1—Niagara #36H-110-3, 100 sq. ft. vert. leaf, T304 SS.
- 1—Alco 110 sq. ft., T316 vert. filter.
- 1—Sparkler #33-S-28, 151 sq. ft. horiz. plate, T304 SS.
- 1—Elmco 18" dia. x 24" face T304 SS rotary vacuum filter.
- 2—Oliver 5'3" dia. x 3' face rot. vac., pressure precoat, T316 SS.
- 1—Oliver 5'3" dia. x 8' face rot. vac., precoat, steel. UNUSED.
- 8—Sharples #AS-16V super cent. Inconel, Vapor-tite, 3 HP.
- 2—Sharples #16P, T304 SS pressure-tite centrifugals.
- 6—Sharples #16 super cent., T304 SS.
- 3—Sharples #C-20 Super-D-Hydrators, T316 SS.
- 2—Bird 18" x 28" horiz. cent., T304 SS or steel.
- 1—Bird 32" x 50" horiz. cent., T316 SS.
- 2—Sperry 30" P. & F. filter presses, 19-9 st. st. (NI-RESIST)

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- 1—2000 sq. ft., T316 SS vert. condenser.
- 1—1960 sq. ft., T316 SS horiz. ex., ASME.
- 12—800 sq. ft. T316 SS heat exchangers, removable bundle.
- 75—T316 tubular heat exchangers & condensers, 2000, 1450, 880, 800, 750, 600, 530, 427, 400, 300, 264, 250, 235, 200, 185, 165, 150, 125, 64, 50, 47, 30 sq. ft.
- 25—Copper & Cupro-Nickel heat exchangers & condensers, up to 1070 sq. ft.

STAINLESS STEEL TANKS

- 1—17,650 gal., horiz., T316 SS, 9' x 36", 1/4" shell, 3/8" dished heads, 40# WP.
- 1—10,000 gal., horiz., T304 SS, 8' x 26", cone heads.
- 1—3700 gal., vert., T304 SS, 6' x 17", VACUUM, int. coils.
- 1—3400 gal., horiz., T304 SS, 6'6" x 16", 1/4" shell, 7/16" dished heads
- 1—3300 gal., vert., T304 SS, 6' x 14'16", 3/8" shell, 3/8" heads, 70# WP.
- 1—2830 gal., horiz., T316 SS, 6' x 12', 5/16" shell & dished heads, VACUUM or 80# WP.
- 3—2750 gal. vert., T316 SS, 7' x 8' dished heads, 50# WP, 75 sq. ft. coll.
- 6—2600 gal. vert., T316 SS, 7' x 8', flat bottom, 19# WP, 5 HP agit.
- 1—2500 gal. vert., T316 SS, 7' x 7', 1/4" shell, 5/16" dished heads, 70# WP.
- 6—2250 gal., vert., T316 SS, 7' x 6'3", dished heads, 70# WP, 5 HP agit.
- 1—1900 gal. vert., T316 SS, 6' x 8', 3/8" shell & dished heads, VAC. or 100# WP.
- 12—1750 gal. vert. hoppers, T304 SS, double cone bottom.
- 4—1200 gal. vert., T316 SS, 5' x 7', cone bottom, VACUUM.
- 100—Tanks & vessels, 100 to 1000 gal., all types, etc.

BEST BUYS

- 12—4500 gal. nickel-clad tanks, 8' dia. x 11' high, cone bottom, 125# WP.
- 1—Struthers-Wells 630 sq. ft. T316 SS evaporator.
- 3—18,000 gal. Aluminum cone-bottom tanks, 12' dia. x 31' OAH.
- 1—1960 sq. ft. T316 SS horiz. exchangers, ASME 75# WP.
- 1—Link-Belt #604-18 roto-louvre dryer, cyclone, fan, etc.
- 3—Worthington 160 ton steam-jet vacuum refig. units.
- 2—Buffalo T316 SS blowers, 2330 cfm, 60 HP TEFC.
- 2—1800 cu. ft. Read T304 SS weigh hoppers, with scales, T304 SS screw conveyor, bucket elevators, AJAX "Lo-veyor" shaker conveyors.
- 1—Patterson 6' x 8' porox-lined pebble mill, 50 HP gearhead.
- 1—Bartlett & Snow 3' x 15' everdur rotary dryer.

STAINLESS REACTORS—KETTLES

- 1—3500 gal. T316 SS, Struthers-Wells, jkt., int. coils, 40/20 HP paddle agit.
- 1—2200 gal. T316 SS, Comb. Eng. jkt. Vacuum int., 7 1/2 HP paddle agit.
- 1—900 gal. T304 SS, PERRY PRODUCTS, 90# jkt., Vacuum int.
- 2—750 gal. T304 SS, GRAVER, 30# jkt., 30# int., ASME, 10 HP turbine agit.
- 1—600 gal., BARTLETT & SNOW, 6' dia. crystallizer, jkt., 25 HP anchoragit.
- 6—465 gal., T304L SS, DOWNINGTOWN, 165# jkt., 150# int. WP.
- 2—125 gal., T304 SS, 30# jkt., 30# int. WP.

STEEL & GLASS LINED REACTORS

- 2—1800 gal. steel, 200# jkt., 6' x 8'8", paddle agit.
- 1—1030 gal. Dopp, Cast Iron, 125# jkt., 25 HP anchor agit.
- 2—1000 gal. Patterson steel dissolvers 15# jkt., 20 HP turbine agit.
- 2—750 gal. Pfaudler glass, jkt., 3-blade agit.
- 1—500 gal., Pfaudler glass, 90# jkt., ASME, 3-blade st. agit.
- 2—400 gal., Glascote steel, 75# jkt., ASME, 3-blade agit.
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- 1—Link Belt steel roto louver dryer, Model 1003-30
- 3—Link Belt steel roto louver dryers, Model 207-10, 310-16, 604-20
- 1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
- 1—Bulovak SS rotary vacuum dryer, 3' x 15'
- 1—Stokes double drum dryer, 5' x 12'
- 1—Louisville rotary steam tube dryer, 8' x 45'
- 2—Louisville rotary dryers, 8' x 50', SS
- 1—Louisville SS rotary kiln, 30" x 28" complete
- 1—Louisville rotary dryer, 38" x 40', Type L
- 1—Traylor 4' x 40' rotary dryer
- 1—Rotary dryer 6' x 36'

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- 3—Dorrco rubber covered filters, 6' x 2'
- 1—Sweetland =3 stainless steel filter
- 12—Sweetland =12 filter with 72 SS leaves
- 1—Niagara SS filter, Model 510-28
- 1—Oliver horizontal filter, 3'
- 1—Oliver type 316 SS precoat filter, 3' x 4'
- 1—Oliver SS pressure precoat filter, 5'3" x 8'
- 10—Shriver plate and frame filter presses, 12" to 42"
- 1—Shriver aluminum 30" x 30" P & F filter press, 30 chambers
- 1—Shriver C. I. plate and frame filter press, 36" x 36" closed deliver, 4 eyes, 60 chambers
- 1—Shriver rubber lined filter press, 36" x 36"

CENTRIFUGES

- 1—Tolhurst SS 20" suspended type centrifuge with perforated basket, complete with plow and motor
- 1—AT&M 26" suspended type centrifuge with SS perforated basket, complete with plow and motor
- 1—AT&M 48" SS suspended type centrifuge, complete with plow, motor and imperforated basket
- 1—Bird type 316 SS centrifuge, 32" x 50"
- 4—Tolhurst center slung rubber covered centrifuges with perforated baskets and motors
- 1—Fletcher 40" center slung rubber covered centrifuges with perforated baskets and motors
- 1—AT&M 40" SS suspended type centrifuge complete with motor, perforated basket and plow



THE GELB GIRL—JANUARY 1960

MIXERS

- 15—Robinson type 304 SS horizontal blenders, 255 cu. ft.
- 3—Robinson type 316 SS sigma blade jacketed heavy duty mixer, 400 gal.
- 1—Baker Perkins Size 16, Type UUEM, 150 gal. jacketed double arm dispersion type mixer, complete with compression cover and 100 HP motor
- 1—12' x 4' pug mixer, type 316 SS
- 1—Patterson type 347 SS jacketed vacuum sigma kneader master, 500 gal.

MISCELLANEOUS

- 1—Cleaver Brooks 500 HP package steam generator, 200=
- 2—Cleaver Brooks package steam generators, 50 and 80 HP, 125=
- 2—Heat Transfer Products steel bubble cap columns, 36" and 42", with 5 and 10 trays
- 1—Acme steel bubble cap column, 42" dia. with 10 trays
- 1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
- 1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
- 1—Vulcan SS bubble cap column, 4' x 28 plates
- 2—Patterson Kelley steel heat exchangers, 1000 sq. ft. each
- 6—Struthers Wells heat exchangers, 685 sq. ft.
- 1—Patterson Kelley steel heat exchanger, 427 sq. ft.
- 50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
- 9—Davis SS heat exchangers, 145 sq. ft. (NEW)
- 1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
- 1—Condenser Service type 316 SS heat exchanger, 350 sq. ft.
- 1—Badger type 316 SS heat exchangers, 500 sq. ft. and 600 sq. ft.
- 3—Robins shaker screens, SS, 3' x 6'
- 1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
- 1—Swenson type 316 SS vacuum crystallizer, 2' x 12'
- 1—Blaw Knox steel distillation column, 36" x 40' with 24 trays (NEW)
- 3—Williams type 316 SS hammermills, Model AK
- 1—Swenson pilot plant spray dryer
- 1—Western Precipitation Corp. stainless steel spray dryer, Type N-2, Size 4-25-E
- 1—Sprout Waldron Model 501-D pelleter
- 1—Ross 6" x 14", 3 roll paint mill, complete

- 1—Downington type 316 SS heat exchanger, 750 sq. ft.
- 6—17,850 gal. steel all welded storage tanks, $\frac{3}{8}$ " material throughout
- 2—Sweco 48" SS separators, Model D-2D-8
- 5—Stokes Model T and R tablet presses

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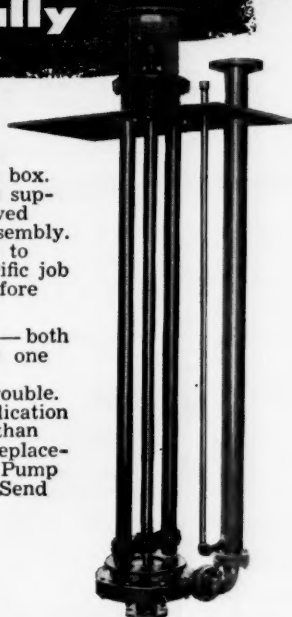
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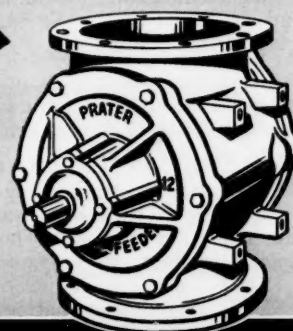
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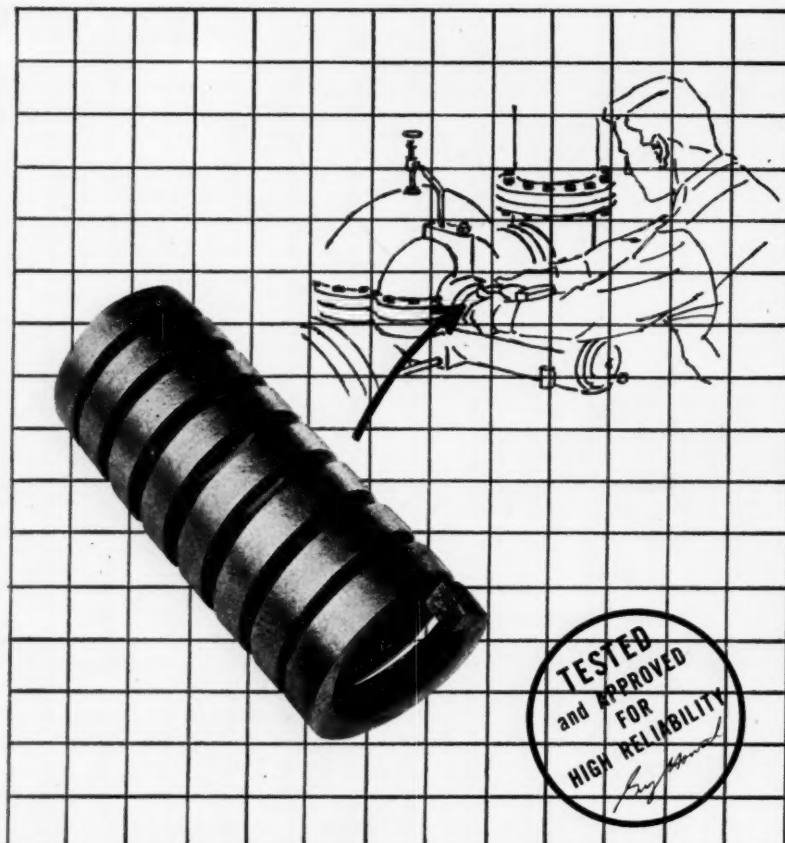
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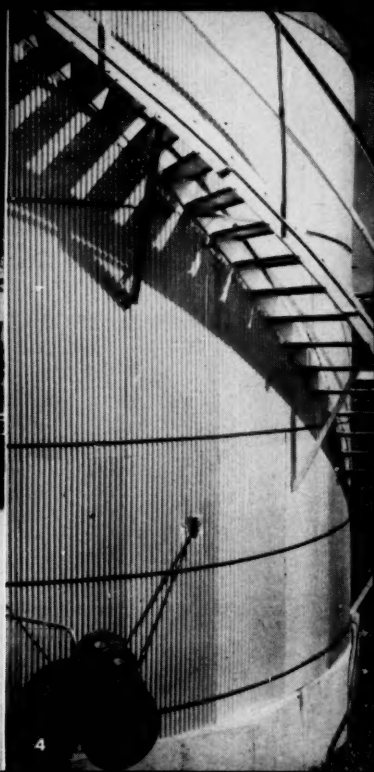
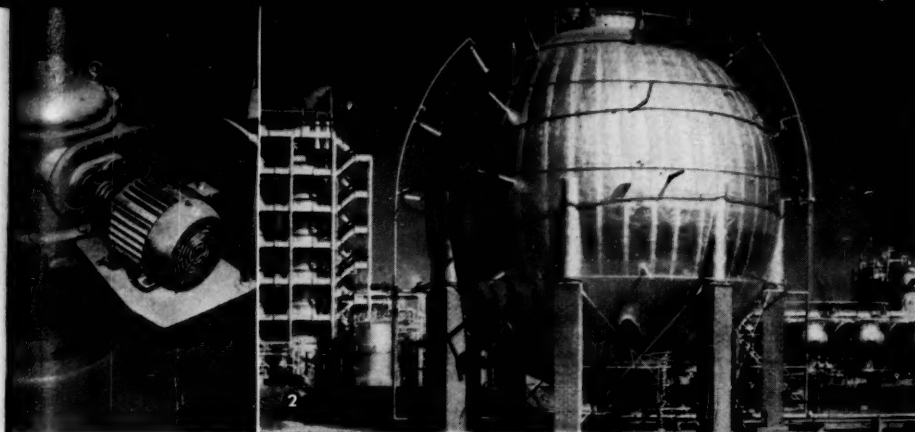
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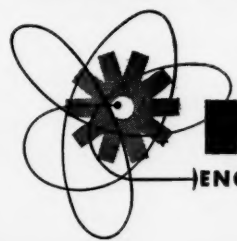
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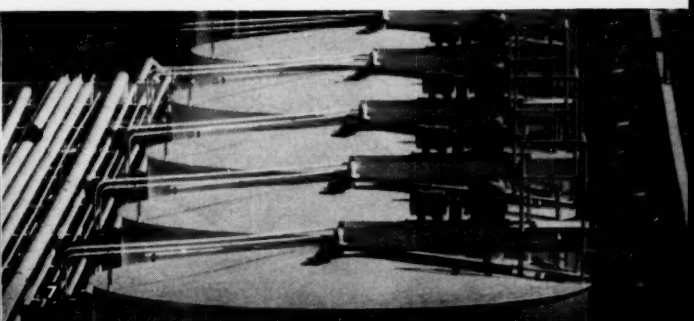
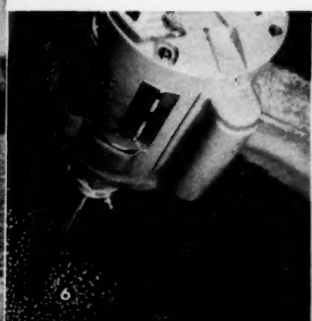
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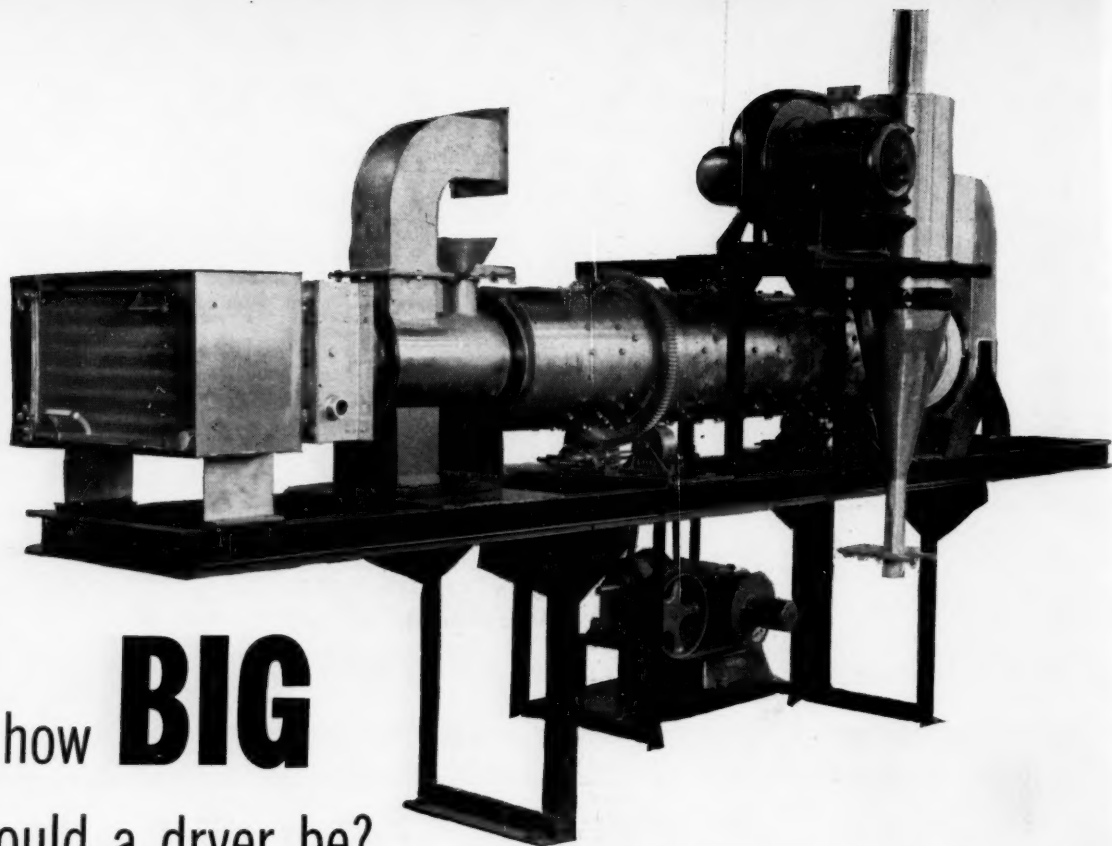
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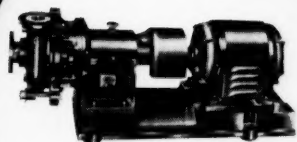


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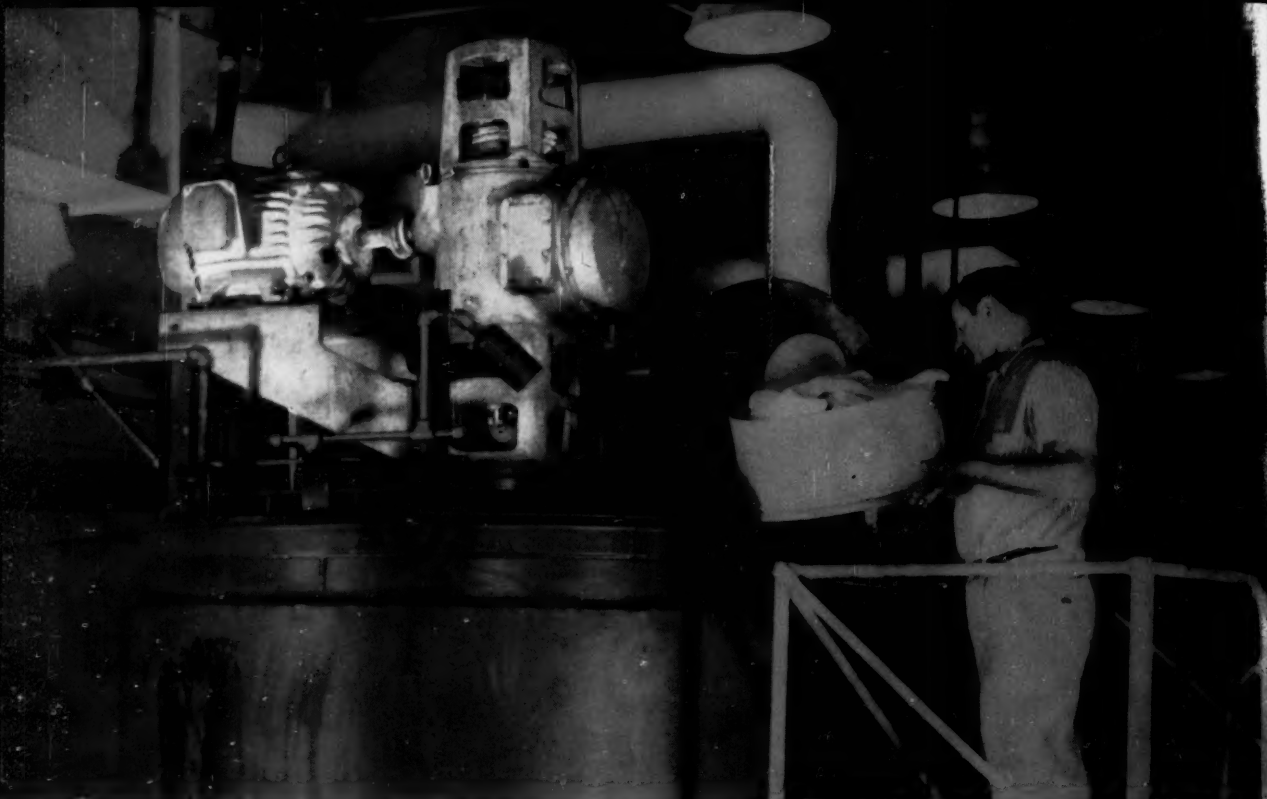
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